United States
Department of
Agriculture

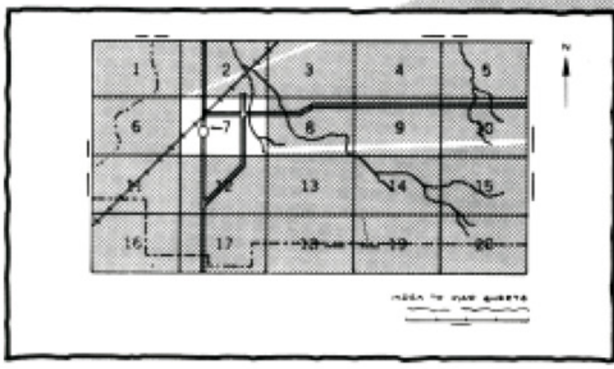
Soil
Conservation
Service

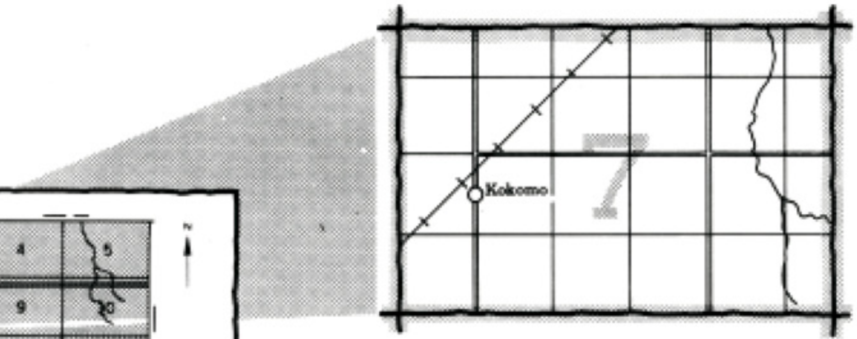
In cooperation with
Kansas Agricultural
Experiment Station

Soil Survey of Lincoln County, Kansas

HOW TO USE

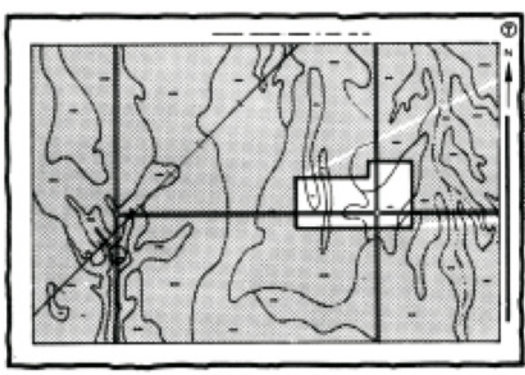
1. Locate your area of interest on the "Index to Map Sheets"

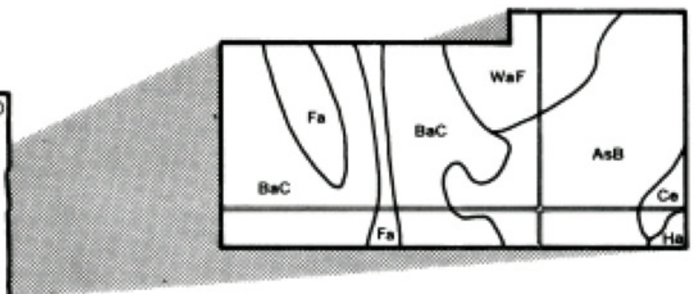




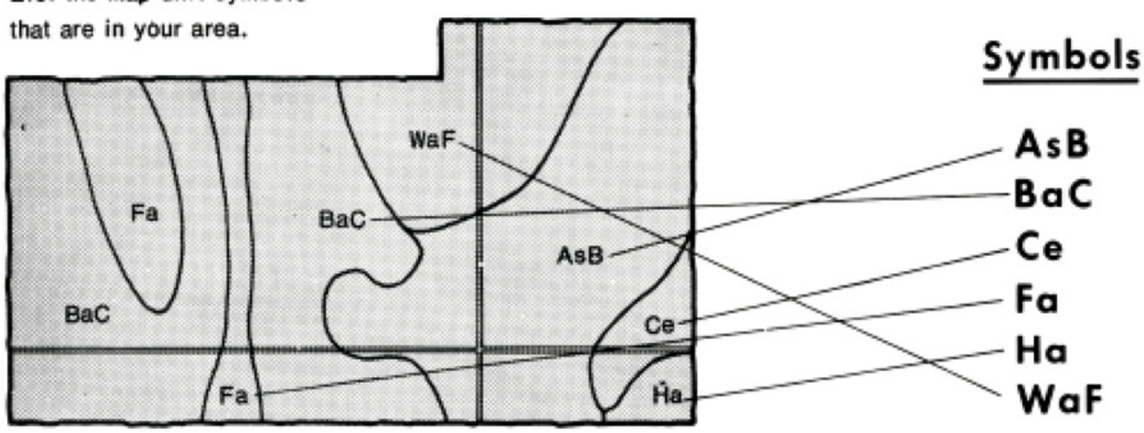
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



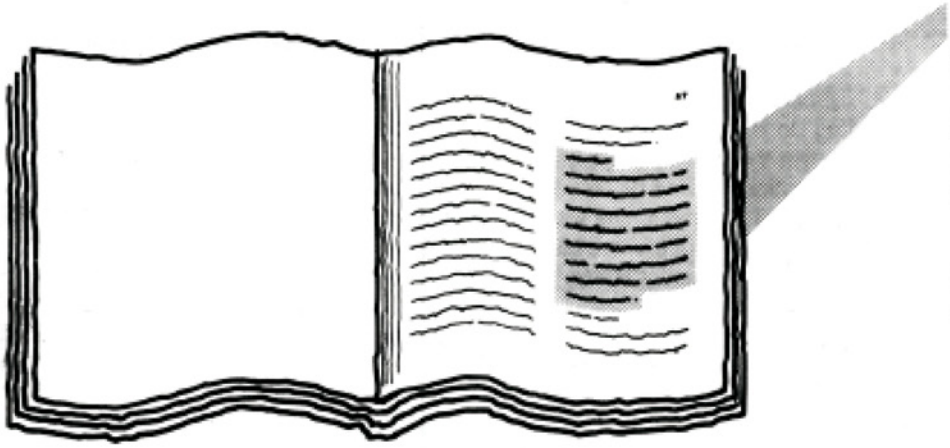


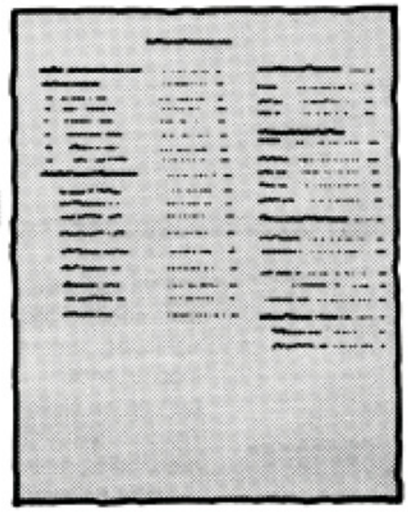
4. List the map unit symbols that are in your area.



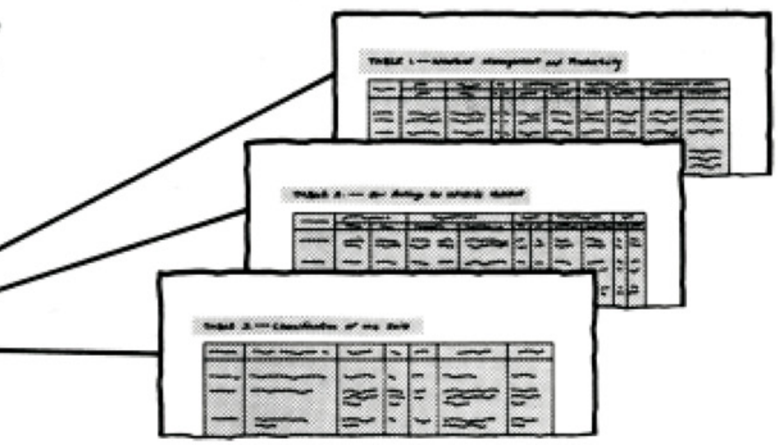
THIS SOIL SURVEY

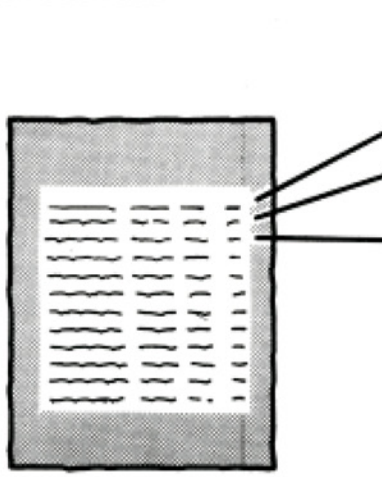
5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.





6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.





7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in 1983. Soil names and descriptions were approved in 1983. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1983. This survey was made cooperatively by the Soil Conservation Service and the Kansas Agricultural Experiment Station. It is part of the technical assistance furnished to the Lincoln County Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: An area of Lancaster-Hedville complex, 3 to 20 percent slopes. Sandstone outcrops are common.

Contents

Soil Series

Issued May 1985

Index to Map Units

Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Lincoln County, Kansas. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

John W. Tippie

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State Conservationist
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Soil Survey of
Lincoln County, Kansas

By Wesley L. Barker and Vernon L. Hamilton,
Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service
In cooperation with the Kansas Agricultural Experiment Station

General Nature of the County

Lincoln County is in north-central Kansas (fig. 1). It has an area of about 461,300 acres, or 720 square miles. In 1980, the population was 4,985. Lincoln, the county seat and largest town, had a population of 1,578. The county was organized in 1870.

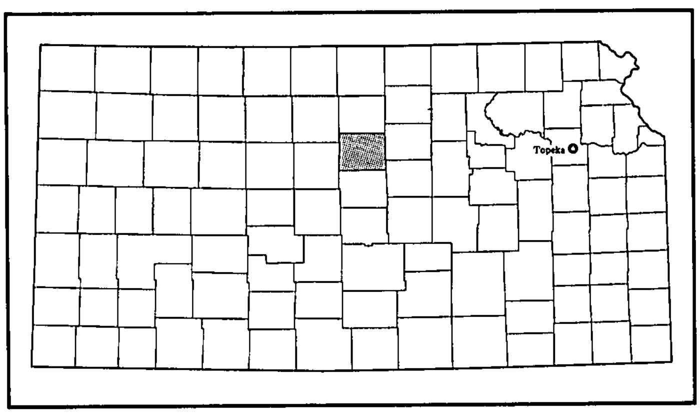

Figure 1.—Location of Lincoln County in Kansas.

The southeast two-thirds of Lincoln County is in the Central Kansas Sandstone Hills land resource area. The remaining one-third is in the Rolling Plains and Breaks land resource area. Generally, the soils are deep, are gently sloping to strongly sloping, and have a silty, loamy, or clayey subsoil. Elevation ranges from 1,800 feet above sea level on the divide between the Saline and Smoky Hill Rivers along the Lincoln-Ellsworth County line to about 1,280 feet in an area adjacent to Salt Creek along the Ottawa County line. Most of the county is drained by the Saline River and its tributaries. The northeast corner is drained by Salt Creek.

Farming and ranching are the main enterprises. According to the 1967 Conservation Needs Inventory, about 53 percent of the county is used for cultivated crops. The principal crops are wheat and grain sorghum.

Climate

Prepared by L. Dean Bark, climatologist, Kansas Agricultural Experiment Station, Manhattan, Kansas.

The climate of Lincoln County is typical continental, as can be expected of a location in the interior of a large land mass in the middle latitudes. It is characterized by large daily and annual variations in temperature. Winter is cold because of frequent outbreaks of polar air, but it lasts only from December through February. Warm summer temperatures last for about 6 months every year. They provide a long growing season for the crops commonly grown in the county. Spring and fall are relatively short.

Lincoln County is generally along the western edge of the flow of moisture-laden air from the Gulf of Mexico. Shifts in this current result in a rather wide range in the annual amount of precipitation. The precipitation is heaviest during the period May through September. A large part of it falls during late-evening or nighttime thunderstorms. In dry years the amount is marginal for farming. Even in wet years, prolonged periods without rain produce stress in growing crops.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Lincoln in the period 1941 to 1970. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 32.2 degrees F, and the average daily minimum temperature is 19.8 degrees. The lowest temperature on record, which occurred at Lincoln on January 14, 1947, is -26 degrees. In summer the average temperature is 78.7 degrees, and the average daily maximum temperature is 92.3 degrees. The highest recorded temperature, which occurred at Lincoln on July 13, 1934, is 119 degrees.

The total annual precipitation is 26.75 inches. Of this, 20.41 inches, or 76 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 15.73 inches. The heaviest 1-day rainfall during the period of record was 7.75 inches at Barnard on July 11, 1951.

The average seasonal snowfall is about 23 inches. The highest recorded seasonal snowfall is 56 inches, which occurred during the winter of 1911-12. On an average of 23 days, at least 1 inch of snow is on the ground, but it is unusual for the snow cover to last over 7 days in succession.

The sun shines 76 percent of the time possible in summer and 64 percent in winter. The prevailing wind is southerly. Average windspeed is highest, 13.4 miles per hour, in April. Average annual windspeed is 11.4 miles per hour.

Tornadoes and severe thunderstorms occur occasionally in Lincoln County. These storms are usually local in extent and of short duration, so that the risk of damage is slight. Hail falls during the warmer part of the year, but the hailstorms are infrequent and of local extent. Hail causes less crop damage in this part of the state than in western Kansas.

Natural Resources

Soil is the most valuable natural resource in Lincoln County. Over 60 percent of the soils in the county are suited to cultivated crops. The steeper soils support good quality native grasses.

Other natural resources include limestone, water, gravel, and sandstone. Some of the sandstone is very hard and is locally referred to as quartzite. This material is mined for road gravel and for use in many cement products. Limestone has been quarried for fenceposts, houses, and road rock. Scattered small gravel pits are on old high stream terraces throughout the county. The gravel from these pits is used primarily as road rock. Water is supplied by surface impoundments, streams, and some springs and wells, primarily in the Dakota Sandstone area. Some of the water in the Dakota Sandstone area is salty. The northwestern part of the county is in a water district. Other water districts are planned for the entire county.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The descriptions and names of the soils identified on the general soil map of this county do not fully agree with those of the soils identified on the maps of adjacent counties. Differences result from a better knowledge of soils, modifications in series concepts, a higher or lower intensity of mapping, and variations in the extent of the soils in the counties.

Soil Descriptions

1. Harney Association

Deep, gently sloping and moderately sloping, well drained soils that have a silty or clayey subsoil; on uplands

This association is on broad ridgetops and side slopes that are dissected by narrow drainageways. Slope ranges from 1 to 7 percent.

This association makes up about 14 percent of the county. It is about 86 percent Harney soils and 14 percent minor soils.

The Harney soils formed in loess. Typically, the surface layer is grayish brown silt loam about 8 inches thick. The subsoil is about 45 inches thick. The upper part is dark grayish brown, firm silty clay loam. The next part is brown, firm silty clay. The lower part is pale brown, friable, calcareous silty clay loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

The minor soils in this association are Corinth, Crete, Nibson, Roxbury, and Wakeen. The moderately deep Corinth soils are on side slopes. The moderately well drained Crete soils are on broad flats in the uplands. The shallow, calcareous Nibson soils and the moderately deep Wakeen soils are on side slopes along drainageways. The calcareous Roxbury soils are on narrow flood plains.

Most of this association is used for cultivated crops. Wheat, grain sorghum, and alfalfa are the major crops. Controlling erosion, conserving moisture, and maintaining good tilth and fertility are the main concerns in managing cropland.

2. Harney-Nibson-Armo Association

Deep and shallow, gently sloping to moderately steep, well drained and somewhat excessively drained soils that have a silty, clayey, or loamy subsoil; on uplands

This association is on ridgetops, side slopes, and foot slopes that are drained by intermittent streams. In some areas it is cut by deeply entrenched drainageways. Slope ranges from 1 to 25 percent.

This association makes up about 33 percent of the county. It is about 31 percent Harney soils, 26 percent Nibson soils, 23 percent Armo soils, and 20 percent minor soils (fig. 2).

The deep, well drained Harney soils formed in loess. They are on ridgetops and side slopes. They are gently sloping and moderately sloping. Typically, the surface layer is grayish brown silt loam about 8 inches thick. The subsoil is about 45 inches thick. The upper part is dark grayish brown, firm silty clay loam. The next part is brown, firm silty clay. The lower part is pale brown, friable, calcareous silty clay loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

The shallow, somewhat excessively drained Nibson soils formed in material weathered from interbedded shale and chalky limestone. They are moderately sloping to moderately steep. They are on ridgetops and side slopes. Typically, the surface layer is dark grayish brown, calcareous silt loam about 7 inches thick. The subsoil is very pale brown, friable, calcareous silty clay loam about 12 inches thick. White shale and chalky limestone are at a depth of about 19 inches.

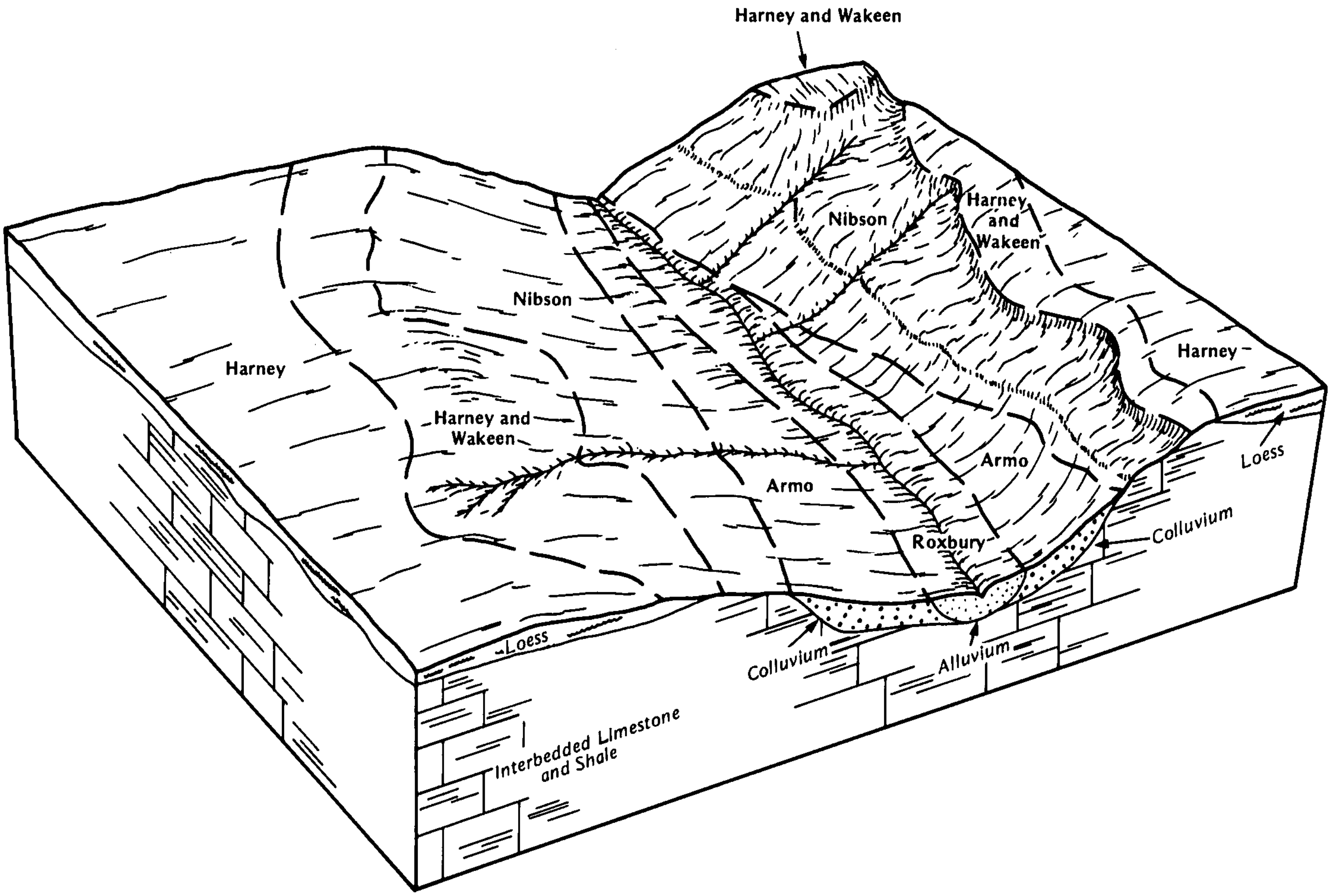

Figure 2.—Typical pattern of soils and parent material in the Harney-Nibson-Armo association.

The deep, well drained Armo soils formed in loamy colluvial sediments weathered mainly from chalky limestone. They are moderately sloping and strongly sloping. They are on foot slopes. Typically, the surface layer is dark grayish brown, calcareous loam about 9 inches thick. The subsurface layer is grayish brown, friable, calcareous loam about 5 inches thick. The subsoil is friable, calcareous clay loam about 26 inches thick. The upper part is pale brown, and the lower part is very pale brown. The substratum to a depth of about 60 inches is very pale brown and calcareous. It is clay loam in the upper part and gravelly clay loam and gravelly loam in the lower part.

The minor soils in this association are Hord, Roxbury, and Wakeen. The deep, silty Hord soils are on stream terraces. The deep, calcareous Roxbury soils are on narrow flood plains. The moderately deep Wakeen soils are on the upper side slopes and on ridgetops.

About 60 percent of this association is used for cultivated crops. The rest is mainly range. Wheat, grain sorghum, and alfalfa are the main crops. Controlling erosion, conserving moisture, and maintaining good tilth and fertility are concerns in managing cropland. Maintaining a good stand of desirable grasses is the main concern in managing range.

3. Geary-Harney-Lancaster Association

Deep and moderately deep, gently sloping to strongly sloping, well drained soils that have a silty, clayey, or loamy subsoil; on uplands

This association is on narrow ridgetops and side slopes that are drained by intermittent streams. Slope ranges from 1 to 10 percent.

This association makes up about 30 percent of the county. It is about 57 percent Geary soils, 16 percent Harney soils, 10 percent Lancaster soils, and 17 percent minor soils (fig. 3).

The deep Geary soils formed in loess. They are moderately sloping and strongly sloping. Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. The subsoil is friable silty clay loam about 33 inches thick. The upper part is brown, and the lower part is reddish brown. The substratum to a depth of about 60 inches is reddish brown silt loam.

The deep Harney soils formed in loess. They are gently sloping and moderately sloping. Typically, the surface layer is grayish brown silt loam about 8 inches thick. The subsoil is about 45 inches thick. The upper part is grayish brown, firm silty clay loam. The next part is brown, firm silty clay. The lower part is pale brown, friable, calcareous silty clay loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

The moderately deep Lancaster soils formed in material weathered from noncalcareous sandstone and sandy shale. They are moderately sloping and strongly sloping. Typically, the surface layer is dark grayish brown loam about 10 inches thick. The subsoil is about 21 inches thick. The upper part is brown, friable loam. The next part is brown, firm clay loam. The lower part is reddish yellow, firm sandy clay loam. Sandy shale is at a depth of about 31 inches.

The minor soils in this association are Edalgo, Hedville, Hord, Tobin, and Wells. The moderately deep Edalgo soils are on the upper side slopes and on narrow, convex ridges. The shallow Hedville soils are on the more sloping, narrow ridgetops and sharp slope breaks. The deep, silty Hord soils are on stream terraces. The deep, silty Tobin soils are on narrow flood plains. The deep, loamy Wells soils are on the lower side slopes.

This association is used mainly for cultivated crops, but about 25 percent is used as range. Wheat, grain sorghum, and alfalfa are the main crops. Controlling erosion, conserving moisture, and maintaining good tilth and fertility are concerns in managing cropland.

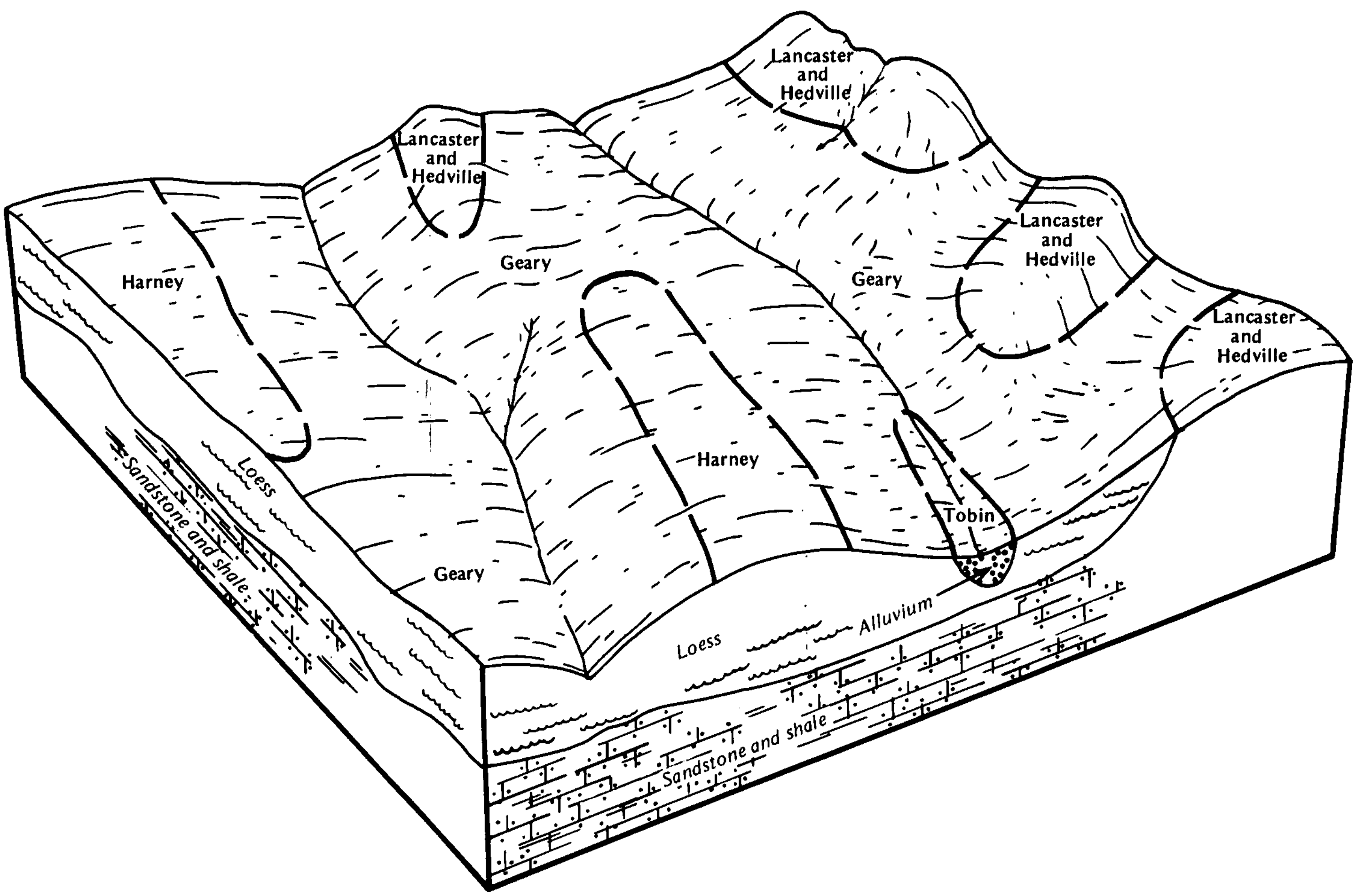

Figure 3.—Typical pattern of soils and parent material in the Geary-Harney-Lancaster association.

Maintaining a good stand of desirable grasses is the main concern in managing range.

4. Lancaster-Hedville Association

Moderately deep and shallow, moderately sloping to moderately steep, well drained and somewhat excessively drained soils that have a loamy subsoil; on uplands

This association is on side slopes, narrow ridgetops, and sharp slope breaks. It is drained by many intermittent drainageways. In some areas it is dissected by deeply entrenched valleys. Shale or sandstone bedrock commonly crops out on the steeper slopes. Slope ranges from 3 to 20 percent.

This association makes up about 12 percent of the county. It is about 40 percent Lancaster soils, 26 percent Hedville soils, and 34 percent minor soils (fig. 4).

The moderately deep, well drained Lancaster soils formed in material weathered from noncalcareous sandstone and sandy shale. They are moderately sloping and strongly sloping. Typically, the surface layer is dark grayish brown loam about 10 inches thick. The subsoil is about 26 inches thick. It is, in sequence downward, brown, friable loam; brown, firm clay loam; reddish yellow, firm sandy clay loam; and reddish yellow, very friable fine sandy loam. Sandy shale is at a depth of about 36 inches.

The shallow, somewhat excessively drained Hedville soils formed in material weathered from noncalcareous sandstone. They are moderately sloping to moderately steep. Typically, the surface layer is grayish brown stony loam about 17 inches thick. Brown and strong brown sandstone is at a depth of about 17 inches.

The minor soils in this association are Edalgo, Geary, Harney, Roxbury, Tobin, and Wells. The moderately deep Edalgo soils have a clayey subsoil. They are on the upper side slopes and on narrow, convex ridges. The deep, silty Geary soils are on the lower side slopes. The deep Harney soils are on ridgetops. The deep Roxbury and Tobin soils are on narrow flood plains. The deep Wells soils are on the lower side slopes.

This association is used mainly as range. The main

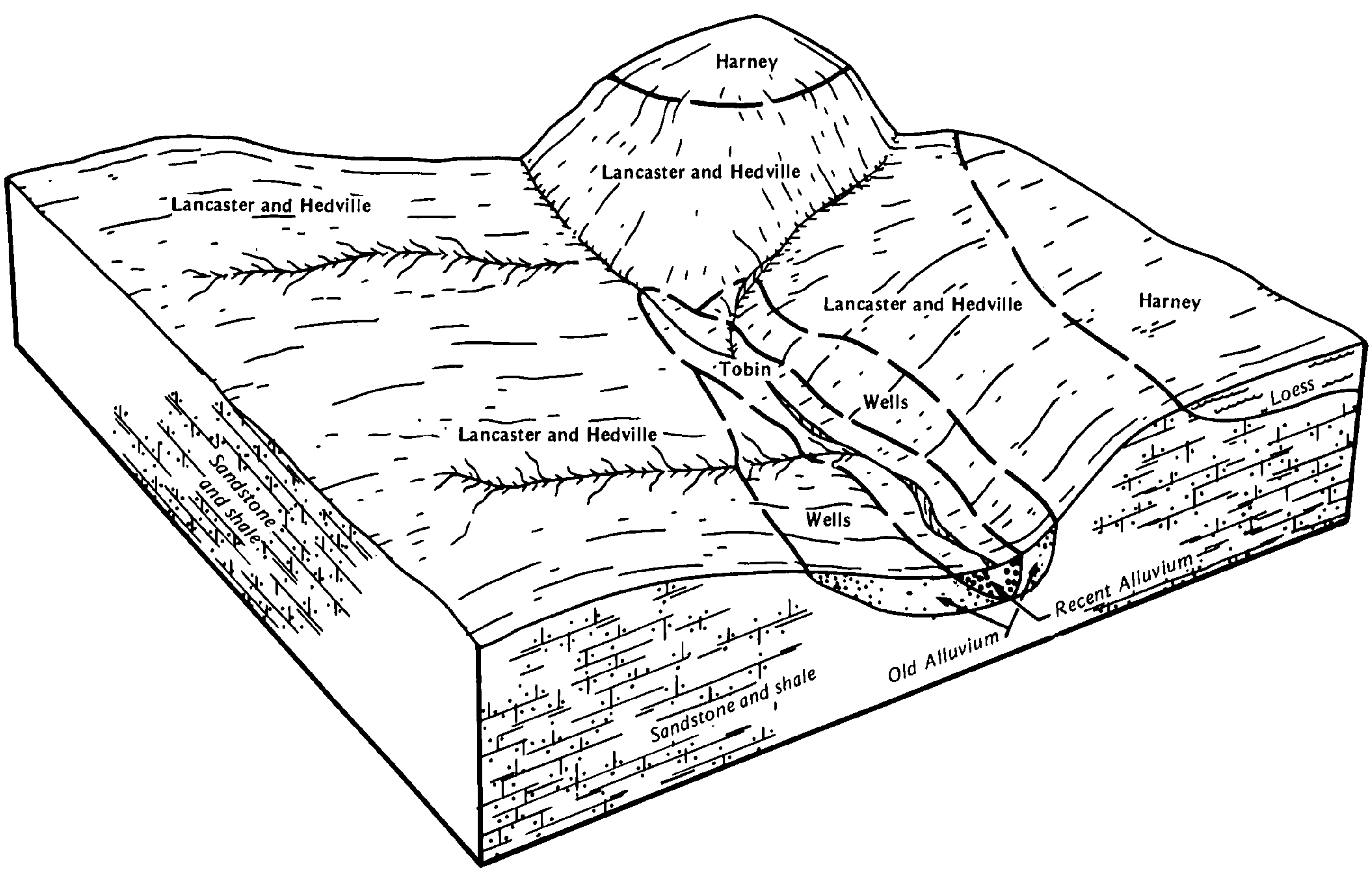

Figure 4.—Typical pattern of soils and parent material in the Lancaster-Hedville association.

management concern is maintaining a vigorous stand of native grasses.

5. Roxbury-New Cambria Association

Deep, nearly level, well drained and moderately well drained soils that have a silty or clayey subsoil; on stream terraces and flood plains

This association is on bottom land along the major streams in the county. The soils are subject to flooding. Slope ranges from 0 to 2 percent.

This association makes up about 11 percent of the county. It is about 55 percent Roxbury soils, 31 percent New Cambria soils, and 14 percent minor soils.

The well drained Roxbury soils formed in calcareous, silty alluvium on stream terraces and flood plains. Typically, the surface layer is dark grayish brown, calcareous silt loam about 6 inches thick. The subsurface layer is dark grayish brown, friable, calcareous silt loam about 8 inches thick. The subsoil is grayish brown, friable, calcareous silty clay loam about 38 inches thick. The substratum to a depth of about 60 inches is brown, calcareous silt loam.

The moderately well drained New Cambria soils formed in calcareous, clayey alluvium on low stream terraces. Typically, the surface layer is dark grayish brown, calcareous silty clay loam about 6 inches thick. The subsurface layer is dark gray, very firm, calcareous silty clay loam about 15 inches thick. The subsoil is very firm, calcareous silty clay about 27 inches thick. The upper part is dark gray, and the lower part is grayish brown. The substratum to a depth of about 60 inches is light brownish gray, calcareous silty clay loam.

The minor soils in this association are Detroit, Hord, McCook, and Tobin. Detroit and Hord soils are in the higher terrace positions that are rarely flooded. McCook soils are adjacent to stream channels. Their subsoil is less clayey than that of the Roxbury and New Cambria soils. Tobin soils are on narrow flood plains on the lower reaches of tributaries of the Saline River. They have a noncalcareous surface layer.

This association is used mainly for cultivated crops. The main crops are wheat, grain sorghum, and alfalfa. Flooding is a hazard in some years. Conserving moisture and maintaining good tilth and fertility are the major concerns in managing cropland.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Harney silt loam, 1 to 3 percent slopes, is one of several phases in the Harney series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Lancaster-Hedville complex, 3 to 20 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, quarries, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

The descriptions and names of the soils identified on the detailed soil maps of this county do not fully agree with those of the soils identified on the maps of adjacent counties. Differences result from a better knowledge of soils, modifications in series concepts, a higher or lower intensity of mapping, and variations in the extent of the soils in the counties.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil Descriptions

Am—Armo loam, 3 to 7 percent slopes. This deep, moderately sloping, well drained soil is on foot slopes below limestone hills. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface soil is dark grayish brown, calcareous loam about 16 inches thick. The subsoil is pale brown, friable, calcareous clay loam about 18 inches thick. The substratum to a depth of about 60 inches is very pale brown and calcareous. The upper part is clay loam, and the lower part is gravelly clay loam and gravelly loam. In places shale and chalky limestone are at a depth of 20 to 40 inches.

Included with this soil in mapping are small areas of the shallow Nibson soils on the upper side slopes. These soils make up about 5 percent of the unit.

Permeability is moderate in the Armo soil. Available water capacity is high. Surface runoff is medium. Organic matter content is moderate, and natural fertility is medium. The soil is mildly alkaline or moderately alkaline throughout. Tilth is good.

About two-thirds of the acreage is used for cultivated crops. The rest is used as range. This soil is moderately well suited to wheat, grain sorghum, forage sorghum, and alfalfa. If cultivated crops are grown, erosion is a

hazard. Contour farming, terraces, grassed waterways, and minimum tillage help to prevent excessive runoff and soil loss. Returning crop residue to the soil helps to maintain tilth and fertility and increases the rate of water infiltration.

This soil is well suited to range. The dominant native vegetation is big bluestem, little bluestem, and sideoats grama. If the range is overgrazed, the growth of the more productive, taller grasses is retarded and less productive, undesirable vegetation invades. Proper stocking rates, timely deferment of grazing, and a uniform distribution of grazing help to keep the range in good condition.

The many areas where cropland is adjacent to range can be managed as habitat for upland wildlife, such as pheasants and quail. Planting shrubs in these areas provides winter cover for the wildlife.

This soil is well suited to dwellings and septic tank absorption fields. It is moderately well suited to sewage lagoons. Seepage and slope are limitations on sites for sewage lagoons. Sealing the lagoon helps to control seepage. If the less sloping areas are selected as sites for lagoons, less leveling and banking are needed during construction.

The land capability classification is IIIe, and the range site is Limy Upland.

Ar—Armo loam, 7 to 15 percent slopes. This deep, strongly sloping, well drained soil is on foot slopes adjacent to limestone hills. Individual areas are irregular in shape and range from 10 to more than 100 acres in size.

Typically, the surface layer is dark grayish brown, calcareous loam about 9 inches thick. The subsurface layer is grayish brown loam about 5 inches thick. The subsoil is friable, calcareous clay loam about 26 inches thick. The upper part is pale brown, and the lower part is very pale brown. The substratum to a depth of about 60 inches is very pale brown and calcareous. It is clay loam in the upper part and gravelly clay loam and gravelly loam in the lower part. In places shale and chalky limestone are at a depth of 20 to 40 inches.

Included with this soil in mapping are small areas of Nibson, Roxbury, and dark gray, clayey soils. The shallow Nibson soils are on the upper side slopes. The Roxbury soils are dark to a depth of more than 20 inches. They are on flood plains along narrow drainageways. The dark gray, clayey soils are on the upper side slopes. Included soils make up about 10 percent of the unit.

Permeability is moderate in the Armo soil. Available water capacity is high. Surface runoff is rapid. Organic matter content is moderate, and natural fertility is medium. The soil is mildly alkaline or moderately alkaline throughout.

Most of the acreage is range. This soil is generally unsuitable for cultivated crops because of a severe hazard of erosion. It is best suited to range. The native vegetation is dominantly big bluestem, little bluestem, and sideoats grama. Overgrazing destroys the protective plant cover and causes deterioration of the plant community. Under these conditions, the more desirable grasses are replaced by less productive grasses and by weeds. Proper stocking rates, a uniform distribution of grazing, and timely deferment of grazing help to keep the range in good condition.

This soil is moderately well suited to dwellings. The slope is a limitation. Land shaping is commonly needed. The soil is moderately well suited to septic tank absorption fields and poorly suited to sewage lagoons. The slope is a limitation affecting both uses. Seepage also is a problem on sites for sewage lagoons. The sanitary facilities should be installed in the less sloping areas. Lateral lines in septic tank systems should be installed on the contour. Sealing the lagoon helps to control seepage.

The land capability classification is VIe, and the range site is Limy Upland.

Cn—Corinth silty clay loam, 3 to 7 percent slopes. This moderately deep, moderately sloping, well drained soil is on side slopes and ridgetops. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is grayish brown, calcareous silty clay loam about 6 inches thick. The subsoil is pale brown, firm, calcareous silty clay about 24 inches thick. Shale is at a depth of about 30 inches. In places the depth to shale is less than 20 inches.

Included with this soil in mapping are small areas of the deep Harney soils on ridgetops. These soils make up about 10 percent of the unit.

Permeability is slow in the Corinth soil. Available water capacity is low. Surface runoff is medium. Organic matter content and natural fertility are low. The soil is mildly alkaline or moderately alkaline throughout. Tilth is generally good. In eroded areas where part of the subsoil has been mixed with the surface layer by tillage, however, working the soil is somewhat difficult. Root development is restricted below a depth of about 30 inches. The subsoil has a high shrink-swell potential.

Most areas are used as range. A small acreage is used for cultivated crops, mainly wheat, grain sorghum, and forage sorghum. This soil is poorly suited to cultivated crops. If cultivated crops are grown, erosion and drought are hazards and the low fertility is a limitation. Terraces, grassed waterways, contour farming, a cover of crop residue, and conservation tillage help to prevent excessive soil loss.

This soil is well suited to range. The native vegetation is dominantly big bluestem, little bluestem, and sideoats grama. If the range is overgrazed, the more desirable grasses are replaced by less productive grasses and the runoff rate is increased. Proper stocking rates, timely

deferment of grazing, and a uniform distribution of grazing help to keep the range in good condition.

This soil is moderately well suited to dwellings. The high shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by shrinking and swelling.

This soil generally is unsuitable as a septic tank absorption field because of the slow permeability and the depth to bedrock. It is only moderately well suited to sewage lagoons. Borrowing soil or ripping the bedrock during construction of the lagoons helps to overcome the moderate depth to bedrock. A sealant for the bottom of the lagoon may be needed to prevent excessive seepage into fractures in the bedrock.

The land capability classification is IVe, and the range site is Limy Upland.

Co—Corinth silty clay loam, 7 to 15 percent slopes. This moderately deep, strongly sloping, well drained soil is on side slopes along upland drainageways. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is grayish brown, calcareous silty clay loam about 6 inches thick. The subsoil is pale brown, calcareous silty clay about 24 inches thick. Shale is at a depth of about 30 inches. In places the surface layer is silty clay.

Included with this soil in mapping are small areas of Nibson and Roxbury soils. The shallow Nibson soils are on the lower side slopes. The Roxbury soils are dark to a depth of more than 20 inches. They are on flood plains along narrow drainageways. Included soils make up about 5 percent of the unit.

Permeability is slow in the Corinth soil. Surface runoff is rapid. Available water capacity is low. Organic matter content and natural fertility also are low. The soil is mildly alkaline or moderately alkaline throughout. Root development is restricted below a depth of about 30 inches. The subsoil has a high shrink-swell potential.

Most areas are used as range. This soil is generally unsuitable for cultivated crops because of a severe hazard of erosion. It is best suited to range. The major concerns of management are the hazard of erosion and the low available water capacity. The native vegetation is dominantly big bluestem, little bluestem, and sideoats grama. Overgrazing retards the growth and reduces the vigor of the grasses and increases the runoff rate. An adequate plant cover reduces the runoff rate and helps to prevent excessive soil loss. Proper stocking rates, a uniform distribution of grazing, and timely deferment of grazing help to keep the range in good condition.

This soil is poorly suited to dwellings. The shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material, however, help to prevent the structural damage caused by shrinking and swelling.

This soil generally is unsuitable as a septic tank absorption field because of the slow permeability and the depth to bedrock. It is poorly suited to sewage lagoons because of the depth to bedrock and the slope. The deeper soils on the lower side slopes are better sites. If the less sloping areas are selected as sites for lagoons, less leveling and banking are needed during construction.

The land capability classification is VIe, and the range site is Limy Upland.

Cr—Crete silt loam, 0 to 2 percent slopes. This deep, nearly level, moderately well drained soil is on broad flats or in slight depressions in the uplands. Individual areas range from 40 to several hundred acres in size.

Typically, the surface layer is dark gray silt loam about 6 inches thick. The subsurface layer is dark grayish brown silty clay loam about 6 inches thick. The subsoil is about 28 inches thick. It is dark grayish brown, firm silty clay in the upper part and grayish brown and pale brown, very firm silty clay in the lower part. The substratum to a depth of about 60 inches is very pale brown silty clay loam. In a few places the subsoil is reddish brown.

Permeability and surface runoff are slow. Available water capacity is high. Organic matter content is moderate, and natural fertility is high. The surface layer is medium acid. Tilth is good. The shrink-swell potential is high in the subsoil.

Nearly all of the acreage is cultivated. This soil is well suited to wheat, grain sorghum, forage sorghum, and alfalfa. Drought is a hazard in some years because the clayey subsoil does not readily release water to plants. Tillage is sometimes delayed in the spring because of wetness. Minimizing tillage and returning crop residue to the soil increase the rate of water infiltration and help to maintain the organic matter content and good tilth.

This soil is moderately well suited to dwellings. The shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by shrinking and swelling.

This soil is poorly suited to septic tank absorption fields because of the slow permeability. The effluent is more readily absorbed if the lateral lines are installed below the clayey subsoil. Enlarging the field also helps to overcome the slow absorption of the effluent. The soil is moderately well suited to sewage lagoons. Seepage in the lower part of the soil can be a problem. In places the clayey subsoil can be used to seal the floor of the lagoon.

The land capability classification is IIs, and the range site is Clay Upland.

De—Detroit silty clay loam. This deep, nearly level, moderately well drained soil is on stream terraces. It is rarely flooded. Individual areas are irregular in shape and range from 15 to 300 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 6 inches thick. The subsurface layer also is dark grayish brown silty clay loam about 6 inches thick. The subsoil is about 48 inches thick. The upper part is dark grayish brown, firm silty clay, and the lower part is grayish brown, firm, calcareous silty clay loam. In places the surface layer is silty clay.

Included with this soil in mapping are small areas of the well drained Roxbury soils along intermittent drainageways. These soils make up about 10 percent of the unit.

Permeability is slow in the Detroit soil. Surface runoff also is slow. Available water capacity is high. Organic matter content is moderate, and natural fertility is high. Reaction is neutral in the surface layer. Tilth is good. The subsoil has a high shrink-swell potential.

Nearly all of the acreage is used for cultivated crops. This soil is well suited to wheat, grain sorghum, forage sorghum, and alfalfa. Drought is a hazard in some years because the clayey subsoil does not readily release water to the plants. Minimizing tillage and returning crop residue to the soil increase the rate of water infiltration and help to maintain the organic matter content, fertility, and good tilth.

This soil is poorly suited to dwellings. Flooding is the main hazard. Also, the shrink-swell potential is a severe limitation. Selecting a site in the highest area on the landscape and constructing dikes, levees, or similar structures help to prevent the damage caused by flooding. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent structural damage caused by shrinking and swelling.

This soil is well suited to sewage lagoons. It is poorly suited to septic tank absorption fields, however, because the slow permeability restricts the absorption of effluent. Enlarging the field helps to overcome this limitation.

The land capability classification is I, and the range site is Loamy Terrace.

Gc—Geary silt loam, 2 to 7 percent slopes. This deep, moderately sloping, well drained soil is on side slopes. Individual areas are long and narrow or irregularly shaped and range from 10 to 100 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. The subsoil is friable and firm silty clay loam about 33 inches thick. The upper part is brown, and the lower part is reddish brown. The substratum to a depth of about 60 inches is reddish brown silt loam. In some places the subsoil is very fine sandy loam. In other places the subsoil and substratum are grayish brown. In eroded areas the surface layer is reddish brown.

Included with this soil in mapping are small areas of calcareous, gravelly soils and a few areas of Lancaster soils. These soils are on the points of ridges and the lower side slopes. They make up less than 5 percent of the unit.

Permeability is moderate in the Geary soil. Surface runoff is medium. Available water capacity is high. Organic matter content is moderate, and natural fertility is high. The surface layer is slightly acid. Tilth is good. The subsoil has a moderate shrink-swell potential.

About three-fourths of the acreage is used for cultivated crops. The rest is used for range. This soil is moderately well suited to wheat, grain sorghum, and forage sorghum. If cultivated crops are grown, erosion is a hazard. Terraces, grassed waterways, and contour farming help to control erosion (fig. 5). Minimizing tillage and leaving crop residue on the surface reduce the runoff rate, increase the rate of water infiltration, and help to maintain organic matter content and good tilth.

This soil is suited to range. The native vegetation is mostly mid and tall grasses, such as little bluestem, big bluestem, and indiangrass. Overgrazing retards the growth and reduces the vigor of the grasses and increases the runoff rate. Under these conditions, the more desirable grasses are replaced by less productive grasses and by weeds. Proper stocking rates, timely deferment of grazing, and a uniform distribution of grazing help to keep the range in good condition.

This soil is moderately well suited to dwellings. The shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by shrinking and swelling.

This soil is moderately well suited to onsite sewage disposal. The moderate permeability somewhat restricts the absorption of effluent in septic tank absorption fields. Enlarging the field helps to overcome this limitation. Seepage and slope are limitations on sites for sewage lagoons. Sealing the floor of the lagoon helps to control seepage. If the less sloping areas are selected as sites for lagoons, less leveling and banking are needed during construction.

The land capability classification is IIIe, and the range site is Loamy Upland.

Gh—Geary-Lancaster complex, 5 to 10 percent slopes. These moderately sloping and strongly sloping, well drained soils are on side slopes and narrow ridgetops. The deep Geary soil is on side slopes below the Lancaster soil. The moderately deep Lancaster soil is on mounds. Individual areas are irregular in shape and range from 20 to a few hundred acres in size. They are about 65 percent Geary soil and 20 percent Lancaster soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Figure 5.—Terraces and a grassed waterway on Geary silt loam, 2 to 7 percent slopes. These measures help to control erosion.

Typically, the Geary soil has a dark grayish brown silt loam surface layer about 8 inches thick. The subsoil is brown and reddish brown silty clay loam about 26 inches thick. It is firm in the upper part and friable in the lower part. The substratum to a depth of about 60 inches is light reddish brown, friable silt loam.

Typically, the Lancaster soil has a dark grayish brown, friable loam surface layer about 10 inches thick. The subsoil is about 21 inches thick. The upper part is brown, friable loam; the next part is brown, firm clay loam; and the lower part is reddish yellow, firm sandy clay loam. Sandy shale is at a depth of about 36 inches. In places the depth to bedrock is more than 40 inches.

Included with these soils in mapping are small areas of Hedville, Edalgo, and gravelly soils. The shallow Hedville soils are on narrow ridgetops. Edalgo soils have a clayey subsoil. They are on side slopes below the Hedville soils and on a few convex slopes. The gravelly soils are calcareous and are on the lower side slopes. Included soils make up about 15 percent of the unit.

Permeability is moderate in both the Geary and Lancaster soils. Surface runoff is medium. Available water capacity is high in the Geary soil and moderate in the Lancaster soil. Organic matter content is moderate in both soils. Natural fertility is high in the Geary soil and medium in the Lancaster soil. The surface layer is slightly acid or medium acid in both soils. Tilth is good. The shrink-swell potential is moderate in the subsoil.

About half of the acreage is used for cultivated crops. The rest is used as range. These soils are poorly suited to cultivated crops. Wheat, grain sorghum, and forage sorghum are the main crops. If cultivated crops are grown, erosion is a severe hazard and rocks on or near the surface interfere with tillage in some areas. Terraces, grassed waterways, and contour farming help to control erosion. Minimizing tillage and leaving crop residue on the surface reduce the runoff rate, increase the rate of water infiltration, and help to maintain organic matter content and good tilth.

These soils are well suited to range. The native vegetation is mostly mid and tall grasses, such as little bluestem, big bluestem, and indiangrass. Overgrazing

retards the growth and reduces the vigor of the grasses and increases the runoff rate. Under these conditions, the more desirable, taller grasses are replaced by less productive grasses and by weeds. Proper stocking rates, timely deferment of grazing, and a uniform distribution of grazing help to keep the range in good condition.

The many areas where cropland is adjacent to range can be managed as habitat for upland wildlife, such as pheasants and quail. Planting shrubs in these areas provides winter cover for the wildlife.

These soils are moderately well suited to dwellings. The moderate shrink-swell potential and the slope are limitations. The depth to bedrock in the Lancaster soil is a limitation on sites for dwellings with basements, but in most areas the rock is soft and can be excavated. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by shrinking and swelling.

The Geary soil is moderately well suited to onsite sewage disposal. The moderate permeability somewhat restricts the absorption of effluent in septic tank absorption fields. Enlarging the field helps to overcome this limitation. The Lancaster soil is generally unsuited to septic tank absorption fields because of the depth to bedrock. Seepage and slope are limitations if these soils are used as sites for sewage lagoons. The depth to bedrock in the Lancaster soil is also a limitation. Borrowing soil or ripping the bedrock during construction of the lagoons helps to overcome the moderate depth to bedrock. A sealant for the bottom of the lagoon may be needed to prevent excessive seepage into fractures in the bedrock. A sealant also helps to prevent seepage in lagoons constructed on the Geary soil. If the less sloping areas are selected as sites for sewage lagoons, less leveling and banking are needed during construction.

The land capability classification is IVe, and the range site is Loamy Upland.

Hb—Harney silt loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on broad upland ridgetops and side slopes. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is grayish brown silt loam about 8 inches thick. The subsoil is about 45 inches thick (fig. 6). The upper part is dark grayish brown, firm silty clay loam. The next part is brown, firm silty clay. The lower part is pale brown, friable, calcareous silty clay loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

Included with this soil in mapping are small areas of Roxbury and Wakeen soils, which make up about 5 percent of the unit. Roxbury soils are calcareous at or near the surface. They are on flood plains along upland

Figure 6.—Profile of Harney silt loam, 1 to 3 percent slopes. The subsoil has subangular blocky structure. Depth is marked in feet.

drainageways. The moderately deep Wakeen soils are on the lower part of some side slopes.

Permeability is moderately slow in the Harney soil. Available water capacity is high. Surface runoff is medium. Organic matter content is moderate, and natural fertility is high. The surface layer is slightly acid or neutral. Tilth is good. The subsoil has a moderate shrink-swell potential.

Most of the acreage is used for cultivated crops (fig. 7). This soil is well suited to wheat, grain sorghum, forage sorghum, and alfalfa. If cultivated crops are grown, erosion is a hazard. Terraces, grassed waterways, contour farming, and a cover of crop residue reduce the runoff rate and help to prevent excessive soil loss (fig. 8). Minimizing tillage and leaving crop residue on the surface increase the rate of water infiltration and help to maintain the organic matter content and good tilth.

The many areas where cropland is adjacent to range can be managed as habitat for upland wildlife, such as pheasants and quail. Planting shrubs in these areas provides winter cover for the wildlife.

This soil is moderately well suited to dwellings. The shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by shrinking and swelling.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The moderately slow permeability somewhat restricts the absorption of effluent in septic tank absorption fields. The effluent is more readily absorbed if the lateral lines are installed below the clayey subsoil. Enlarging the field also helps to overcome the slow absorption of effluent. Seepage is a limitation on sites for sewage lagoons. It can be controlled by sealing the floor of the lagoon. In places the more clayey part of the subsoil can be used as a sealer.

The land capability classification is IIe, and the range site is Loamy Upland.

Hc—Harney silty clay loam, 3 to 7 percent slopes. This deep, moderately sloping, well drained soil is on side slopes. Individual areas are irregular in shape and range from 10 to 120 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 6 inches thick. The subsoil is about 44 inches thick. The upper part is dark grayish brown, firm silty clay loam; the next part is brown, firm silty clay; and the lower part is pale brown, friable, calcareous silty clay loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In some places the depth to lime is less than 18 inches. In other places the subsoil and substratum are reddish brown.

Included with this soil in mapping are small areas of the moderately deep Wakeen soils on the lower side slopes. These soils make up about 3 percent of the unit.

Permeability is moderately slow in the Harney soil. Available water capacity is high. Surface runoff is medium. Organic matter content is moderate, and natural fertility is high. The surface layer is slightly acid or neutral. Tilth is fair. The subsoil has a moderate shrink-swell potential.

About two-thirds of the acreage is used for cultivated crops. The rest is used as range. This soil is moderately well suited to wheat, grain sorghum, and alfalfa. If cultivated crops are grown, erosion is a hazard. Terraces, grassed waterways, contour farming, and a cover of crop residue help to prevent excessive runoff and soil loss. Minimizing tillage and leaving crop residue on the surface increase the rate of water infiltration and help to maintain organic matter content and tilth.

This soil is well suited to range. Big bluestem, little bluestem, sideoats grama, and western wheatgrass are the dominant grasses. An adequate plant cover and ground mulch reduce the runoff rate, help to prevent excessive soil loss, and increase the moisture supply. Proper stocking rates, deferred grazing, and a uniform distribution of grazing help to keep the range in good condition.

In many areas cropland is adjacent to range. These areas can be readily managed as habitat for upland wildlife, such as pheasants and quail. Planting shrubs provides winter cover for the wildlife.

This soil is moderately well suited to dwellings. The shrink-swell potential in the subsoil is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by shrinking and swelling.

This soil is moderately well suited to onsite sewage disposal. The moderately slow permeability somewhat restricts the absorption of effluent in septic tank absorption fields. The effluent is more readily absorbed if the lateral lines are installed below the clayey subsoil. Enlarging the field also helps to overcome the slow absorption of effluent. Seepage and slope are limitations on sites for sewage lagoons. Sealing the lagoon helps to control seepage. In places the more clayey part of the subsoil can be used to seal the floor of the lagoon. The less sloping areas are the best sites for lagoons.

The land capability classification is IIIe, and the range site is Loamy Upland.

Hf—Harney-Wakeen complex, 2 to 7 percent slopes. These moderately sloping, well drained soils are on uplands. The deep Harney soil is on side slopes and narrow ridgetops above the Wakeen soil. The moderately deep Wakeen soil is on the more sloping, lower part of the landscape. Individual areas are irregular in shape and range from 20 to a few hundred acres in size. They are about 75 percent Harney soil and 20 percent Wakeen soil. The two soils occur as areas so

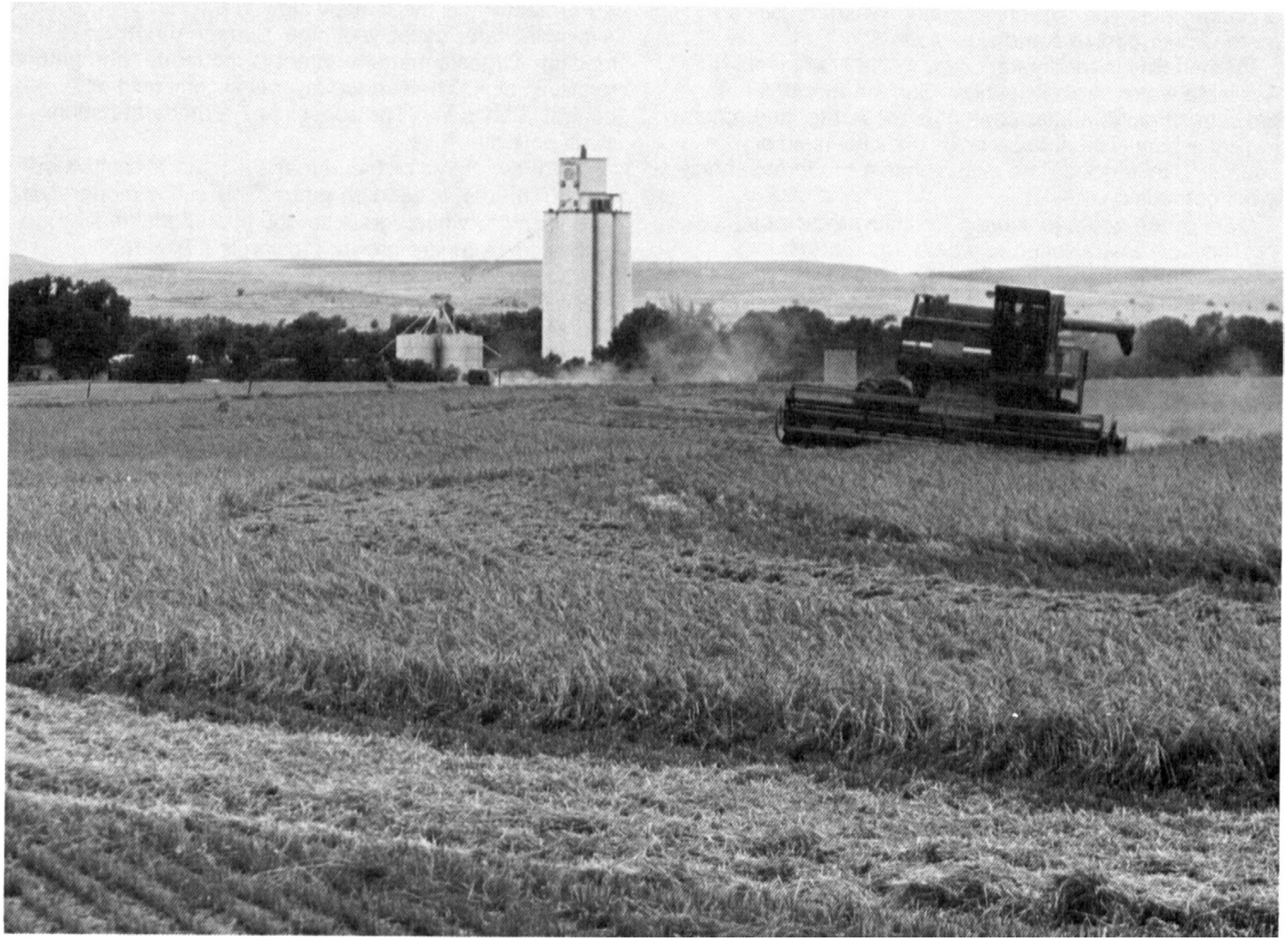

Figure 7.—Harvesting wheat on Harney silt loam, 1 to 3 percent slopes. This soil is well suited to wheat.

intricately mixed or so small that mapping them separately is not practical.

Typically, the Harney soil has a dark grayish brown silty clay loam surface layer about 6 inches thick. The subsoil is about 44 inches thick. The upper part is dark grayish brown, firm silty clay loam; the next part is brown, firm silty clay; and the lower part is pale brown, friable, calcareous silty clay loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

Typically, the Wakeen soil has a dark grayish brown, calcareous silt loam surface layer about 11 inches thick. The subsoil is firm, calcareous silty clay loam about 24 inches thick. The upper part is dark grayish brown, and the lower part is grayish brown. Chalky limestone is at a depth of about 35 inches.

Included with these soils in mapping are small areas of the shallow Nibson soils, which are on the lower part of some slopes. Tilling the Nibson soils is difficult and can result in damage to implements. Included soils make up about 5 percent of the unit.

Permeability is moderately slow in the Harney soil and moderate in the Wakeen soil. Surface runoff is medium on both soils. Available water capacity is high in the Harney soil and moderate in the Wakeen soil. Natural fertility is high in the Harney soil and medium in the Wakeen soil. The Harney soil is slightly acid or neutral in the surface layer, and the Wakeen soil is mildly alkaline or moderately alkaline throughout. Tilth is fair in Harney soil and good in Wakeen soil. The subsoil in both soils has a moderate shrink-swell potential.

About half of the acreage is used for cultivated crops. The rest is used as range. These soils are poorly suited to cultivated crops. Wheat, grain sorghum, and alfalfa are the main crops. If cultivated crops are grown, erosion is a severe hazard and the rocks on or near the surface interfere with tillage in a few areas. Terraces, grassed waterways, contour farming, and a cover of crop residue help to prevent excessive runoff and soil loss. Minimizing tillage and leaving crop residue on the surface increase the rate of water infiltration and help to maintain organic matter content and tilth.

These soils are suited to range. The major concerns of management are erosion and low forage production on abandoned cropland. Big bluestem, little bluestem, and indiangrass are the dominant grasses. An adequate plant cover and ground mulch reduce the runoff rate, help to prevent excessive soil loss, and increase moisture supply. Proper stocking rates, deferred grazing, and a uniform distribution of grazing help to keep the range in good condition.

In many areas cropland is adjacent to range. These areas can be readily managed as habitat for upland wildlife, such as pheasants and quail. Planting shrubs provides winter cover for the wildlife.

These soils are moderately well suited to dwellings. The moderate shrink-swell potential in the subsoil is a limitation. The depth to bedrock in the Wakeen soil is also a limitation, but the rock is soft in most areas and can be ripped and excavated. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by shrinking and swelling.

Figure 8.—Plowing up a terrace ridge on Harney silt loam, 1 to 3 percent slopes. Plowing helps to maintain the proper height of the ridge.

The Harney soil is moderately well suited to onsite sewage disposal. The moderately slow permeability somewhat restricts the absorption of effluent in septic tank absorption fields. The effluent is more readily absorbed if the lateral lines are installed below the clayey subsoil. Enlarging the field also helps to overcome the slow absorption of the effluent. Seepage and slope are limitations on sites for sewage lagoons. Sealing the lagoon helps to control seepage. In places the more clayey part of the subsoil can be used to seal the floor of the lagoon. The Wakeen soil is poorly suited to onsite sewage disposal systems because of the depth to bedrock. The deeper adjacent soils are better sites.

The land capability classification is IVe. The Harney soil is in the Loamy Upland range site, and the Wakeen soil is in the Limy Upland range site.

Ho—Hord silt loam. This deep, nearly level, well drained soil is on stream terraces. It is subject to rare flooding. Individual areas are irregular in shape and range from 20 to 200 acres in size.

Typically, the surface layer is dark gray silt loam about 6 inches thick. The subsurface layer also is dark gray silt loam about 6 inches thick. The subsoil is friable silt loam about 28 inches thick. The upper part is dark grayish brown, and the lower part is grayish brown. The substratum to a depth of about 60 inches is pale brown, calcareous silt loam. In places the soil is calcareous near the surface.

Included with this soil in mapping are small areas of Detroit and New Cambria soils, which make up about 10 percent of the unit. These moderately well drained soils are in slight depressions.

Permeability is moderate in the Hord soil. Available water capacity is high. Surface runoff is slow. Organic matter content is moderate, and natural fertility is high. The surface layer is slightly acid or neutral. Tilth is good.

Most of the acreage is used for cultivated crops. This soil is well suited to wheat, grain sorghum, forage sorghum, and alfalfa. Minimizing tillage and leaving crop residue on the surface increase the rate of water infiltration and help to maintain the organic matter content and good tilth.

This soil is poorly suited to dwellings because of the flooding. Selecting the highest area on the landscape and constructing dikes or levees help to prevent the damage caused by flooding.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. Flooding is a hazard on sites for septic tank systems, and seepage is a limitation on sites for sewage lagoons. Dikes and levees help to prevent the damage caused by flooding. Sealing the sewage lagoon helps to control seepage.

The land capability classification is I, and the range site is Loamy Terrace.

Lh—Lancaster-Hedville complex, 3 to 20 percent slopes. These moderately sloping to moderately steep soils are on side slopes and narrow ridgetops, which are dissected by deeply entrenched drainageways. The moderately deep, well drained Lancaster soil is on the less sloping side slopes above the Hedville soil. The shallow, somewhat excessively drained Hedville soil is on the narrow ridgetops and sharp slope breaks. Individual areas are irregular in shape and range from 20 to several hundred acres in size. They are about 50 percent Lancaster soil and 40 percent Hedville soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Lancaster soil has a dark grayish brown loam surface layer about 10 inches thick. The subsoil is about 26 inches thick. The upper part is brown, friable loam; the next part is brown, firm clay loam; and the lower part is reddish yellow, firm sandy clay loam and very friable fine sandy loam. Sandy shale is at a depth of about 36 inches. In places the depth to bedrock is more than 40 inches.

Typically, the Hedville soil has a grayish brown stony loam surface soil about 17 inches thick. Brown and strong brown sandstone is at a depth of about 17 inches.

Included with these soils in mapping are areas of Armo and Edalgo soils and sandstone rock outcrops. The deep, calcareous Armo soils are on the lower side slopes. Edalgo soils have a clayey subsoil. They are on side slopes below the Hedville soil. The sandstone rock outcrops are on steep slopes near areas of the Hedville soil. Included areas make up about 10 percent of the unit.

Permeability is moderate in the Lancaster and Hedville soils. Surface runoff is rapid. Available water capacity is moderate in the Lancaster soil and very low in the Hedville soil. Organic matter content is moderate in both soils, and natural fertility is medium. The surface layer of the Lancaster soil is slightly acid, and that of the Hedville soil is neutral. Root penetration is restricted below a depth of about 36 inches in the Lancaster soil and below a depth of about 17 inches in the Hedville soil. The shrink-swell potential is moderate in the subsoil of the Lancaster soil.

Nearly all areas are used as range (fig. 9). These soils generally are unsuited to cultivated crops because erosion is a severe hazard and because rocks on or near the surface interfere with tillage in many areas. The soils are suited to range. The native vegetation is dominantly big bluestem, little bluestem, and indiangrass. Overgrazing reduces the extent of the plant cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses and by weeds, such as tall dropseed, Baldwin ironweed, and western ragweed. Proper stocking rates, a uniform distribution of grazing, timely deferment of grazing, and rotation grazing help to keep the range in

good condition. Sites that are suitable for stock water ponds generally are available in the larger areas of these soils. Many areas are also suitable for the development of springs, which can be used as a supply of stock water.

The Lancaster soil is moderately well suited to dwellings. The shrink-swell potential and the slope are limitations. Also, the depth to bedrock is a limitation on sites for dwellings with basements, but in most areas the rock is soft and can be easily excavated. Properly designing and reinforcing foundations and footings help to prevent the structural damage caused by shrinking and swelling. Less land shaping is needed if the smoother, less sloping areas are selected as sites for dwellings.

The Lancaster soil is poorly suited to septic tank absorption fields and sewage lagoons because of the depth to bedrock. The slope is an additional limitation on sites for lagoons. Borrowing soil or ripping the bedrock during construction of the lagoons helps to overcome the moderate depth to bedrock. A sealant for the bottom of the lagoon may be needed to prevent excessive seepage into fractures in the bedrock. The deeper included soils on foot slopes are better sites for sewage disposal systems.

The Hedville soil generally is unsuitable as a site for dwellings, septic tank absorption fields, and sewage lagoons because of the depth to bedrock and the slope.

The land capability classification is VIe. The Lancaster soil is in the Loamy Upland range site, and the Hedville soil is in the Shallow Sandstone range site.

Mc—McCook silt loam. This deep, nearly level, well drained soil is on terraces along the major streams. It is subject to rare flooding. Individual areas are irregular in shape and range from 50 to a few hundred acres in size.

Typically, the surface layer is grayish brown, calcareous silt loam about 6 inches thick. The subsurface layer also is grayish brown, calcareous silt loam. It is very friable and is about 8 inches thick. The next layer is light brownish gray, very friable, calcareous silt loam about 11 inches thick. The substratum to a depth of about 60 inches is light gray, calcareous very fine sandy loam.

Permeability is moderate. Surface runoff is slow. Available water capacity is high. Organic matter content is moderate, and natural fertility is high. The soil is mildly alkaline or moderately alkaline throughout. The surface layer is very friable. Tilth is good.

Nearly all of the acreage is used for cultivated crops. This soil is well suited to wheat, grain sorghum, forage sorghum, and alfalfa. The main management needs are measures that control soil blowing and keep the level of fertility high. Minimizing tillage and returning crop residue to the soil conserve moisture and help to maintain the organic matter content and fertility.

The areas where cropland is adjacent to grassland or woodland provide habitat for many kinds of wildlife, including deer, quail, and numerous songbirds. Good woodland management increases the wildlife population.

This soil generally is unsuited to building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is I, and the range site is Loamy Terrace.

Nc—New Cambria silty clay loam, occasionally flooded. This deep, nearly level, moderately well drained soil is on low stream terraces. Individual areas are irregular in shape and range from 10 to 160 acres in size.

Typically, the surface layer is dark grayish brown, calcareous silty clay loam about 6 inches thick. The subsurface layer is dark gray, very firm, calcareous silty clay loam about 15 inches thick. The subsoil is very firm, calcareous silty clay about 27 inches thick. The upper part is dark gray, and the lower part is grayish brown. The substratum to a depth of about 60 inches is light brownish gray, calcareous silty clay loam. In places the depth to calcareous material is more than 10 inches.

Included with this soil in mapping are small areas of Hord, McCook, and Roxbury soils, which make up about 15 percent of the unit. The included soils are less clayey than the New Cambria soil. They are on slightly convex, low ridges.

Permeability is slow in the New Cambria soil. Surface runoff also is slow. Available water capacity is high. Organic matter content is moderate, and natural fertility is high. The surface layer is mildly alkaline or moderately alkaline. Tilth is fair. If this soil is tilled when too wet, tilth is further destroyed and large clods form on the surface. The shrink-swell potential is high.

Most of the acreage is used for cultivated crops. This soil is well suited to wheat, grain sorghum, forage sorghum, and alfalfa. Planting and tillage are delayed during some wet periods. Drainage ditches help to remove excess surface water. In periods when the amount of rainfall is low, the clayey subsoil restricts the movement of water into the soil and releases moisture slowly to plants. Minimizing tillage and returning crop residue to the soil increase the rate of water infiltration and conserve moisture (fig. 10).

This soil generally is unsuited to building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is IIw, and the range site is Clay Lowland.

Ns—Nibson-Wakeen silt loams, 5 to 25 percent slopes. These moderately sloping to moderately steep soils are on upland ridges and side slopes. The shallow, somewhat excessively drained Nibson soil is on sharp slope breaks and side slopes. The moderately deep, well

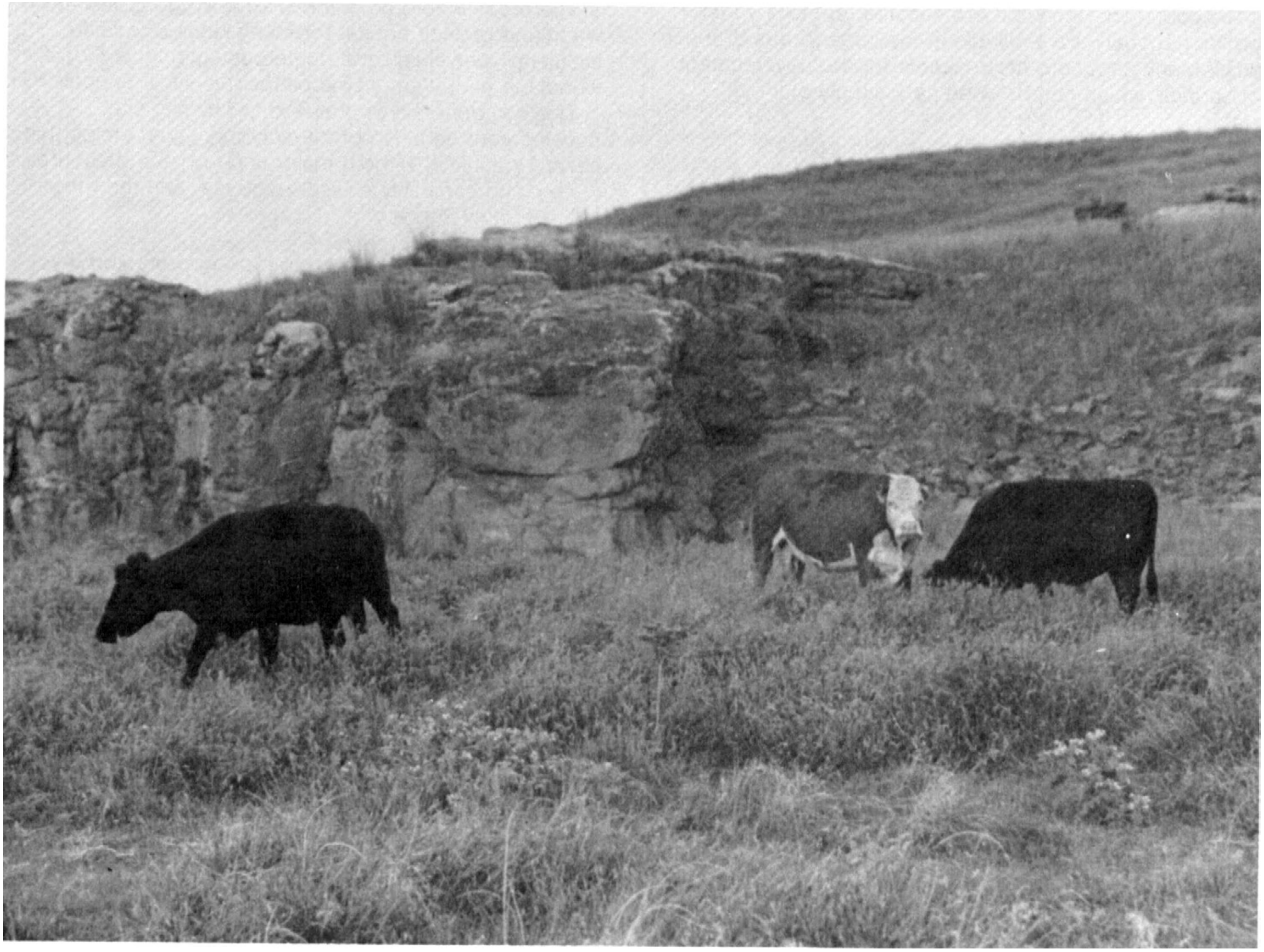

Figure 9.—An area of Lancaster-Hedville complex, 3 to 20 percent slopes, used as range. The native grasses are a dependable source of feed for cattle.

drained Wakeen soil is on the less sloping ridges above the Nibson soil. Individual areas are mostly narrow and irregular in shape and range from 5 to several hundred acres in size. They are about 75 percent Nibson soil and 20 percent Wakeen soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Nibson soil has a dark grayish brown, calcareous silt loam surface layer about 7 inches thick. The subsoil is very pale brown, friable, calcareous silty clay loam about 12 inches thick. White shale and chalky limestone are at a depth of about 19 inches.

Typically, the Wakeen soil has a dark grayish brown, calcareous silt loam surface layer about 11 inches thick. The subsoil is firm, calcareous silty clay loam about 24 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. Very pale brown chalky limestone is at a depth of about 35 inches.

Included with these soils in mapping are small areas of Armo and Harney soils and limestone outcrops. The deep Armo soils are on the lower side slopes. Harney soils are on the smoother slopes on the upper part of the landscape. The limestone outcrops are on steep breaks. Included areas make up about 5 percent of the unit.

Permeability is moderate in the Nibson and Wakeen soils. Surface runoff is rapid on the Nibson soil and medium on the Wakeen soil. Available water capacity is

low in the Nibson soil and moderate in the Wakeen soil. Organic matter content is moderately low in the Nibson soil and moderate in the Wakeen soil. Natural fertility is low in the Nibson soil and medium in the Wakeen soil. Both soils are mildly alkaline or moderately alkaline throughout. Root penetration is restricted below a depth of about 19 inches in the Nibson soil and 35 inches in the Wakeen soil. The shrink-swell potential is moderate in the subsoil of both soils.

Most areas support native grasses. These soils are best suited to range. They generally are unsuited to cultivated crops because erosion is a severe hazard and because rocks on or near the surface interfere with tillage in many areas. The native vegetation is dominantly big bluestem, little bluestem, and sideoats grama. Overgrazing reduces the extent of the plant cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses and by weeds, such as tall dropseed and western ragweed. Proper stocking rates, a uniform distribution of grazing, timely deferment of grazing, and rotation grazing help to keep the range in good condition. Sites that are suitable for stock water ponds generally are available.

The Wakeen soil is moderately well suited to dwellings. The shrink-swell potential and the slope are limitations. Also, the depth to bedrock is a limitation on sites for dwellings with basements, but the rock is soft in most areas and can be excavated. Properly designing and reinforcing foundations and footings help to prevent

Figure 10.—Milo stubble on New Cambria silty clay loam, occasionally flooded. The stubble conserves moisture by trapping snow.

the structural damage caused by shrinking and swelling. Some land shaping is commonly needed.

The Wakeen soil is generally unsuited to septic tank absorption fields and sewage lagoons because of the depth to bedrock and the slope. The deep adjacent soils are better sites for sanitary facilities.

The Nibson soil is generally unsuitable as a site for dwellings, septic tank absorption fields, and sewage lagoons because of the depth to bedrock and the slope.

The land capability classification is VIe, and the range site is Limy Upland.

Pt—Pits, quarries. This map unit is in areas where gravel, sandstone, limestone, and fill material have been excavated for use as road material, as a source of sand, and in the manufacturing of cement products. Individual areas are irregular in shape and range from 5 to 200 acres in size.

These pits generally are surrounded by nearly vertical walls 6 to 40 feet high. They support little vegetation. Scattered trees, shrubs, and clumps of grass border the quarries.

This unit is unsuited to cultivation and most other uses. It is suited to reclamation for range or wildlife habitat.

No capability classification or range site is assigned to this unit.

Rb—Roxbury silt loam. This deep, nearly level, well drained soil is on terraces along the larger streams in the county. It is subject to rare flooding. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is dark grayish brown, calcareous silt loam about 6 inches thick. The subsurface layer is dark grayish brown, friable, calcareous silt loam about 8 inches thick. The subsoil is grayish brown, friable, calcareous silty clay loam about 38 inches thick. The substratum to a depth of about 60 inches is brown, calcareous silt loam. In some places the subsoil is very fine sandy loam. In other places the soil is more clayey throughout.

Permeability is moderate. Surface runoff is slow. Available water capacity is very high. Organic matter content is moderate, and natural fertility is high. The soil is mildly alkaline or moderately alkaline throughout. Tilth is good. The subsoil has a moderate shrink-swell potential.

Most areas are used for cultivated crops. This soil is well suited to grain sorghum, wheat, and alfalfa (fig. 11). The main concern of management is maintaining soil tilth and fertility. Returning crop residue to the soil and minimizing tillage increase the rate of water infiltration and help to maintain organic matter content, fertility, and good tilth.

This soil is poorly suited to dwellings because of the flooding. It is moderately well suited to septic tank absorption fields and to sewage lagoons. Flooding is a hazard on sites for septic tank systems, and seepage is a limitation on sites for lagoons. Building houses and sanitary facilities in the highest areas and constructing dikes and levees help to prevent the damage caused by flooding. Sealing the lagoon helps to control seepage.

The land capability classification is I, and the range site is Loamy Terrace.

Rc—Roxbury silt loam, channeled. This deep, nearly level, well drained soil is on flood plains along small creeks and intermittent drainageways. It is frequently flooded. Individual areas are 150 to 650 feet wide and 500 to 8,000 feet long. They range from 5 to 100 acres in size.

Typically, the surface soil is dark grayish brown, calcareous silt loam about 22 inches thick. The subsoil is grayish brown, friable, calcareous silt loam about 10 inches thick. The substratum to a depth of about 60 inches is grayish brown, calcareous silt loam. In some places the subsoil is very fine sandy loam. In other places the surface soil is clay loam. In some areas the soil is more clayey throughout.

Permeability is moderate. Surface runoff is slow. Available water capacity is very high. Organic matter content is moderate, and natural fertility is high. The soil is mildly alkaline or moderately alkaline throughout. The subsoil has a moderate shrink-swell potential.

Most areas are used as range. This soil generally is not suited to cultivated crops because flooding is a hazard and operating ordinary farm equipment is difficult along the meandering stream channels. The soil is suited to range. The range commonly is overgrazed and in poor condition because it is in areas where livestock congregate near watering facilities and shade trees. In these areas the more desirable grasses, such as big bluestem, indiangrass, and switchgrass, are replaced by less productive grasses and by weeds. Proper stocking rates, a uniform distribution of grazing, and timely deferment of grazing help to keep the range in good condition.

The vegetation common on this soil provides food and cover for many kinds of wildlife, including quail, deer, rabbits, and songbirds. The wildlife population can be increased by planting trees and shrubs along the border of the closest cropland.

This soil generally is unsuitable for building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is Vw, and the range site is Loamy Lowland.

Rf—Roxbury silt loam, occasionally flooded. This deep, nearly level, well drained soil is on flood plains along rivers, creeks, and intermittent drainageways. It is occasionally flooded for very brief periods. Individual areas range from 250 to 1,200 feet wide and from 1/4

Figure 11.—Swathing alfalfa hay on Roxbury silt loam.

mile to more than 2 miles long. They range from 10 to 300 acres in size.

Typically, the surface soil is dark grayish brown, calcareous silt loam about 24 inches thick. The subsoil is grayish brown, friable, calcareous silt loam about 12 inches thick. The substratum to a depth of about 60 inches is grayish brown, calcareous silt loam. In places the subsoil is loam or clay loam.

Permeability is moderate. Surface runoff is slow. Available water capacity is very high. Organic matter content is moderate, and natural fertility is high. The soil is mildly alkaline or moderately alkaline throughout. The surface soil is friable. Tilth is good. The subsoil has a moderate shrink-swell potential.

About two-thirds of the acreage is cultivated. The rest is used as range. This soil is well suited to wheat, grain sorghum, forage sorghum, alfalfa, and hay and pasture. Floodwater damages crops in some years, but in other years the extra moisture increases productivity. Dikes and diversions help to prevent crop damage. Minimizing tillage and returning crop residue to the soil increase the rate of water infiltration and help to maintain the organic matter content, fertility, and good tilth.

This soil is suited to range. In many areas, however, the range is overgrazed and in poor condition. In these areas the more productive grasses, such as big bluestem, indiangrass, and switchgrass, are replaced by less productive grasses and by weeds. Proper stocking rates, timely deferment of grazing, and a uniform distribution of grazing help to keep the range in good condition. Placing salt blocks on the steeper adjacent soils helps to distribute grazing evenly.

This soil generally is unsuitable for building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is IIw, and the range site is Loamy Lowland.

Sa—Saltine silty clay loam, frequently flooded. This deep, nearly level, somewhat poorly drained, saline-alkali soil is on flood plains. Individual areas are irregular in shape and range from 20 to 80 acres in size.

Typically, the surface soil is dark grayish brown and grayish brown, calcareous silty clay loam about 22 inches thick. The substratum to a depth of about 60 inches is firm, calcareous silty clay loam. The upper part is grayish brown, and the lower part is pale brown. In places the surface layer is silty clay.

Included with this soil in mapping are small areas of New Cambria soils and slick spots. The slick spots are extremely high in content of sodium salts and are white when dry. They are sometimes covered with water. The moderately well drained New Cambria soils are in the slightly higher landscape positions. Included areas make up about 5 percent of the unit.

Permeability is slow in the Saltine soil. Surface runoff also is slow. Available water capacity is moderate because of the excessive amount of exchangeable sodium. A seasonal high water table is at a depth of 2 to 3 feet. Natural fertility is low, and organic matter content is moderate. This soil has excessive amounts of exchangeable sodium and soluble salts. The shrink-swell potential is high.

Most of the acreage is used as range. Because of the excess sodium and the seasonal high water table, this soil generally is not suited to cultivated crops. It is suited to range. The native vegetation is mostly prairie cordgrass, inland saltgrass, sedges, and western wheatgrass. A few areas have no plant cover because of the excessive salts. Overgrazing or grazing when the soil is wet causes surface compaction, retards plant growth, and reduces the vigor of the grasses. Proper stocking rates, timely deferment of grazing, and a uniform distribution of grazing help to keep the range in good condition.

This soil generally is unsuited to building site development because of flooding and wetness.

The land capability classification is VIs, and the range site is Saline Subirrigated.

To—Tobin silt loam, occasionally flooded. This deep, nearly level, well drained soil is on flood plains along creeks that drain loess and Dakota sandstone areas. It is occasionally flooded for very brief periods. Individual areas are mostly long and less than 800 feet wide. They range from 5 to 150 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer also is dark grayish brown silt loam. It is friable and is about 22 inches thick. The next layer is dark grayish brown, friable silt loam about 15 inches thick. The substratum to a depth of about 60 inches is brown, friable silt loam. In places the surface layer is calcareous.

Included with this soil in mapping are small areas of the moderately well drained Detroit soils. These soils are in the slightly higher landscape positions. They make up less than 10 percent of the unit.

Permeability is moderate in the Tobin soil. Surface runoff is slow. Available water capacity is very high. Natural fertility is high, and organic matter content is moderate. The surface layer is slightly acid or neutral. Tilth is good. The shrink-swell potential is moderate.

Most of the acreage is used for cultivated crops. The rest is used as range. This soil is well suited to wheat, grain sorghum, forage sorghum, and alfalfa. Floodwater damages crops in some years, but in other years the extra moisture increases productivity. Dikes and diversions help to prevent crop damage. Minimizing tillage and returning crop residue to the soil increase the rate of water infiltration and help to maintain the organic matter content, fertility, and good tilth.

This soil is well suited to range. In many places, however, the range is overgrazed and in poor condition. In these areas the more desirable grasses are replaced by less productive grasses and by weeds. Proper stocking rates, timely deferment of grazing, and a uniform distribution of grazing help to keep the range in good condition. Placing salt blocks on the steeper adjacent soils helps to distribute grazing evenly.

The areas where cropland is adjacent to grassland or woodland provide habitat for many kinds of wildlife, including deer, quail, and numerous songbirds. Good woodland management increases the wildlife population.

This soil generally is unsuitable for building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is IIw, and the range site is Loamy Lowland.

Wg—Wells-Edalgo complex, 3 to 7 percent slopes. These moderately sloping, well drained soils are on side slopes and narrow ridgetops. The deep Wells soil is on side slopes below the Edalgo soil. The moderately deep Edalgo soil is on the upper side slopes and on narrow, convex ridgetops. Individual areas are irregular in shape and range from about 15 acres to a few hundred acres in size. They are about 70 percent Wells soil and 15 percent Edalgo soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Wells soil has a brown loam surface layer about 6 inches thick. The subsurface layer is brown, friable clay loam about 7 inches thick. The subsoil is about 39 inches thick. The upper part is reddish brown, firm clay loam, and the lower part is yellowish red, friable sandy clay loam. The substratum to a depth of about 60 inches is reddish yellow sandy loam. In a few places sandstone bedrock is at a depth of 20 to 40 inches.

Typically, the Edalgo soil has a dark grayish brown, friable silt loam surface layer about 6 inches thick. The subsoil is firm silty clay about 30 inches thick. The upper

part is dark reddish gray, the next part is reddish brown, and the lower part is reddish brown and pink. Shale is at a depth of about 36 inches.

Included with these soils in mapping are small areas of rock outcrop and Hedville soils. The shallow Hedville soils and rock outcrop are on narrow ridgetops. Included areas make up about 15 percent of the unit.

Permeability is moderate in the Wells soil and very slow in the Edalgo soil. Surface runoff is medium on the Wells soil and rapid on the Edalgo soil. Available water capacity is high in the Wells soil and low in the Edalgo soil. Organic matter content is moderate in both soils. Natural fertility is high in the Wells soil and medium in the Edalgo soil. The surface layer of both soils is medium acid. Tilth is good. The shrink-swell potential is moderate in the subsoil of the Wells soil and high in the subsoil of the Edalgo soil.

About half of the acreage is used for cultivated crops. The rest is used for range. These soils are poorly suited to cultivated crops. Wheat, grain sorghum, and forage sorghum are the main crops. If cultivated crops are grown, erosion is a severe hazard and rocks on or near the surface interfere with tillage in some areas. Terraces, grassed waterways, and contour farming help to control erosion. Minimizing tillage and leaving crop residue on the surface reduce the runoff rate, increase the rate of water infiltration, and help to maintain organic matter content and good tilth.

These soils are well suited to range. The native vegetation is mostly mid and tall grasses, such as little bluestem, big bluestem, indiangrass, and switchgrass. Overgrazing retards the growth and reduces the vigor of the grasses and increases the runoff rate. Under these conditions, the more desirable, taller grasses are replaced by less productive grasses and by weeds. Proper stocking rates, timely deferment of grazing, and a uniform distribution of grazing help to keep the range in good condition.

The many areas where cropland is adjacent to range can be managed as habitat for upland wildlife, such as pheasants. Planting shrubs in these areas provides winter cover for the wildlife.

The Wells soil is moderately well suited to dwellings, and the Edalgo soil is poorly suited. The shrink-swell potential in the subsoil is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by shrinking and swelling.

The Wells soil is well suited to septic tank absorption fields. It is moderately well suited to sewage lagoons. The slope and seepage are limitations. Sealing the lagoon helps to control seepage. If the less sloping areas are selected as sites for the lagoons, less leveling and banking are needed during construction.

The Edalgo soil generally is unsuited to septic tank absorption fields because of the very slow permeability. It is poorly suited to sewage lagoons. Borrowing soil or ripping the bedrock during construction of the lagoons helps to overcome the moderate depth to bedrock. A sealant for the bottom of the lagoon may be needed to prevent excessive seepage into fractures in the bedrock.

The land capability classification is IVe. The Wells soil is in the Loamy Upland range site, and the Edalgo soil is in the Clay Upland range site.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cropland, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber or is available for those uses. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to economically produce a sustained high yield of crops. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland usually has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 7 percent. More detailed information about the criteria for prime farmland is available at local offices of the Soil Conservation Service.

About 250,000 acres in Lincoln County, or 54 percent of the total acreage, meets the soil requirements for prime farmland. This acreage occurs as scattered areas throughout the county but is mainly in soil associations 1, 2, 3, and 5, which are described under the heading "General Soil Map Units." About 75 percent of the prime farmland is used for cultivated crops.

The soil map units in Lincoln County that are considered prime farmland are listed in this section. The list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that

affect use and management are described in the section "Detailed Soil Map Units."

The map units that meet the soil requirements for prime farmland are:

Am	Armo loam, 3 to 7 percent slopes
Cr	Crete silt loam, 0 to 2 percent slopes
De	Detroit silty clay loam
Gc	Geary silt loam, 2 to 7 percent slopes
Hb	Harney silt loam, 1 to 3 percent slopes
Hc	Harney silty clay loam, 3 to 7 percent slopes
Ho	Hord silt loam
Mc	McCook silt loam
Nc	New Cambria silty clay loam, occasionally flooded
Rb	Roxbury silt loam
Rf	Roxbury silt loam, occasionally flooded
To	Tobin silt loam, occasionally flooded

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops

John C. Dark, conservation agronomist, Soil Conservation Service, helped prepare this section.

General management needed for crops is suggested in this section. The crops best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 53 percent of the acreage in Lincoln County was used for cultivated crops during the period 1970 to 1980. During this period, wheat was grown on about 51 percent of the cropland, sorghum on 13 percent, and alfalfa hay on 9 percent (*3*). An average of 35,000 acres, or 14 percent of the cropland, was summer fallowed. Corn, oats, rye, barley, and soybeans were grown on a small percent of the arable cropland.

The acreage planted to wheat has gradually increased in recent years, whereas that planted to other crops has decreased or remained relatively constant. Less than 2,000 acres is irrigated.

Soil erosion is the major problem on about 80 percent of the cropland in the county. If the slope is more than 1 percent, erosion is a hazard.

Loss of the surface layer through erosion is damaging because it reduces productivity and results in sedimentation of streams. Productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into a plow layer. Loss of the surface layer is especially damaging on soils that have a clayey subsoil. Control of erosion minimizes the pollution of streams by sediment and improves the quality of water.

Measures that control erosion provide a protective plant cover, reduce the runoff rate, and increase the infiltration rate. A cropping system that keeps a protective plant cover on the surface for extended periods reduces the risk of erosion and preserves the productive capacity of the soil.

Terraces and diversions reduce the length of slopes and thus help to control runoff and erosion. They are most practical on deep, well drained soils that have uniform, regular slopes. Many of the arable soils in the county have those characteristics. Contour tillage should be used in combination with terraces. It is best suited to those soils that have smooth, uniform slopes and can be terraced.

A conservation tillage system that leaves crop residue on the surface increases the infiltration rate and reduces

the runoff rate and the hazard of erosion. Also, the extra cover helps to control soil blowing. This practice is being used on an increasing acreage in the county.

Soil tilth is the physical condition of the soil, especially the soil structure as related to the growth of plants. Soils with good tilth are granular and porous. Tilth has important effects on the infiltration of water into the soil and on seedbed preparation. It is a major concern affecting all soils, particularly eroded soils in which the clayey subsoil has been mixed with the surface layer. Tilth indirectly affects crop production through its effect on the amount of water available for plant growth.

Soil tests help to determine the need for soil amendments, such as nitrogen, phosphorus, and potassium. The needs of the crop, the expected level of yields, and the experience of farmers are factors to be considered when soil amendments are added. The Cooperative Extension Service can help to determine the kinds and amounts of nutrients to be applied.

Further information about managing cropland can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in table 5.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States,

shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in table 5.

Rangeland

Kenneth L. Hladek, range conservationist, Soil Conservation Service, helped prepare this section.

About 190,168 acres in Lincoln County, or 43 percent of the total acreage, is rangeland. Slightly more than 36 percent of the farm income in the county is derived from the sale of livestock, principally cattle.

Most of the livestock enterprises in the county are of the cow-calf type (fig. 12), especially in the northeastern and southwestern two-thirds of the county. The rangeland in these areas tends to occur as larger and more continuous tracts. Small stock farms are throughout the county in scattered areas where smaller acreages of rangeland are interspersed among the larger areas of cropland.

A few livestock producers extend the grazing season by supplemental grazing of cool-season tame grass pastures, principally bromegrass. Many also supplement the grassland forage with grain sorghum crop residue, some small grain winter pastures, and during most winters, hay and protein concentrates.

Soils strongly influence the potential natural plant community for any given area within the county. The soils and climate of the county generally can support a Mixed Grass Prairie. These communities are dominated by the bluestems (*Andropogon*) and grama grasses (*Boutelous*). The eastern part of the county, which is underlain by the Dakota Sandstone Formation, can support a somewhat unique natural plant community. It is a transition zone between the Mixed Prairie farther to the west and the Tall Grass Prairie farther to the east. The dominant grass species, however, are most like the Bluestem Prairie. These communities are potentially dominated by the bluestems, switchgrass (*Panicum virgatum*), and indiangrass (*Sorghastrum nutans*).

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 6 shows, for each soil, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as rangeland or are suited to use as rangeland are listed. An explanation of the column headings in table 6 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre of air-dry vegetation. Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush species,

Figure 12.—A young calf resting in tall native grasses.

conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Controlled grazing is one of the major management needs on the rangeland in Lincoln County. It helps to ensure that the major plant species of the natural plant community are either maintained or improved. Forage production has been reduced in some areas because the natural plant community has been depleted by excessive grazing. Proper stocking rates and a uniform distribution of grazing are needed to maintain the rangeland in the county. Timely deferment of grazing, a planned grazing system, weed control, limited brush control, and reseeding of marginal cropland can improve the rangeland.

Windbreaks, Environmental Plantings, and Native Woodland

Keith A. Ticknor, forester, Soil Conservation Service, helped prepare this section.

About 1 percent of Lincoln County is forested. The wooded areas, other than windbreaks and shelterbelts, are scattered throughout the county in irregular tracts and narrow bands along the streams and rivers and their major tributaries. The Roxbury-New Cambria association,

which is described in the section "General Soil Map Units," includes most of the woodland in the county.

The woodland is mostly in the cottonwood forest cover type, in which eastern cottonwood makes up a majority of the stands. Cottonwood is a temporary cover type and is followed by the hackberry-American elm-green ash forest cover type. This transition is apparent in areas along the streams where the dominant species range from eastern cottonwood and black willow to hackberry, American elm, and green ash. Black walnut is in most of these areas, but the best trees have been cut. Other associated species include boxelder, Russian mulberry, bur oak, and Kentucky coffee tree.

Many of the trees have value for commercial wood products, but they are scattered and do not occur in large enough concentrations to be of commercial value.

The soils on bottom land have good potential for Christmas trees and the trees used in the production of veneer, sawtimber, firewood, and other wood products. Most of these soils are used as cropland, however, and are not likely to be converted to forest uses.

Landowners have established windbreaks and environmental plantings on most of the ranch headquarters and farmsteads in the county (fig. 13). Eastern redcedar, honeylocust, and Siberian elm make up a majority of the windbreaks at the headquarters (fig. 14). Some of the other trees and shrubs used as windbreaks and environmental plantings include black locust, oriental arborvitae, Russian mulberry, hackberry, osageorange, and lilac.

Many windbreaks and environmental plantings are established each year. Tree planting is a continual need because old trees deteriorate after they pass maturity, because some trees die as a result of insects, diseases, or storms, and because new plantings are needed in areas where farmsteads are expanded.

Many field windbreaks or shelterbelts are throughout the county. Shelterbelts generally consist of 8 to 10 rows of trees and shrubs. Common species are eastern redcedar, ponderosa pine, Russian-olive, black locust, honeylocust, green ash, osageorange, Siberian elm, and American plum. Hedgerows of osageorange have been planted throughout the county to mark property lines and field boundaries, to form living fences, and to provide a source of posts. Many field windbreaks have been removed because fields are being enlarged.

In order for windbreaks and environmental plantings to fulfill their intended purpose, the soils on the site should be suited to the trees or shrubs selected for planting. Permeability, available water capacity, fertility, soil depth, and texture are soil characteristics that greatly affect the growth rate.

Establishing trees and shrubs is somewhat difficult in Lincoln County because of limited moisture. As a result, properly preparing a site prior to planting and controlling weeds or other competing vegetation after planting are the major concerns in establishing and managing a windbreak. Drip irrigation or other supplemental watering methods can help to overcome moisture deficiencies.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife (fig. 15). Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

Robert J. Higgins, biologist, Soil Conservation Service, helped prepare this section.

Lincoln County has several areas of scenic, geologic, and historic interest. The watershed lakes in the northern half of the county provide recreational opportunities for many area residents. Farm ponds and the Saline River provide additional opportunities for water sports. The fall hunting season draws many pheasant hunters to Lincoln County.

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent or its suitability for a lagoon system and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding

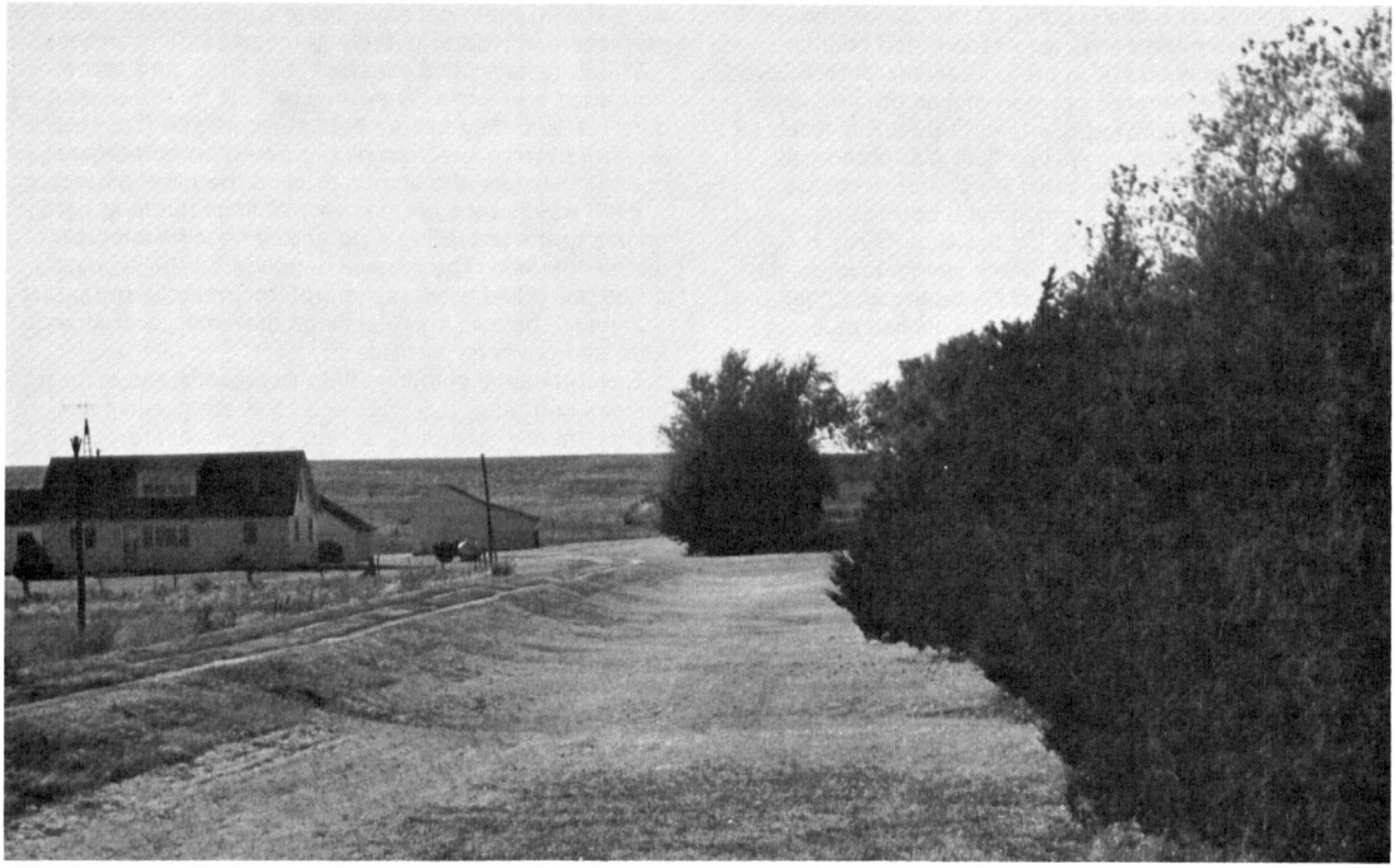

Figure 13.—A windbreak protecting driveway and farmstead from cold north winds and snow.

occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the

depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

Robert J. Higgins, biologist, Soil Conservation Service, helped prepare this section.

The primary game species in Lincoln County are pheasant, bobwhite quail, cottontail rabbit, prairie chicken, white-tailed deer, and several species of waterfowl. The pheasant season attracts many hunters to the county.

Nongame species of wildlife in the county are numerous because the habitat types are diverse. Cropland, woodland, and grassland are intermixed throughout the county. The transition zone, or edge between these habitat types, provides habitat for most wildlife species.

Furbearers are common along most of the streams. They are trapped on a limited basis.

Watershed lakes, the Saline River, and farm ponds provide good to excellent fishing. The species commonly caught are largemouth bass, bluegill, crappie, carp, channel cat, bullhead, and flathead catfish.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect

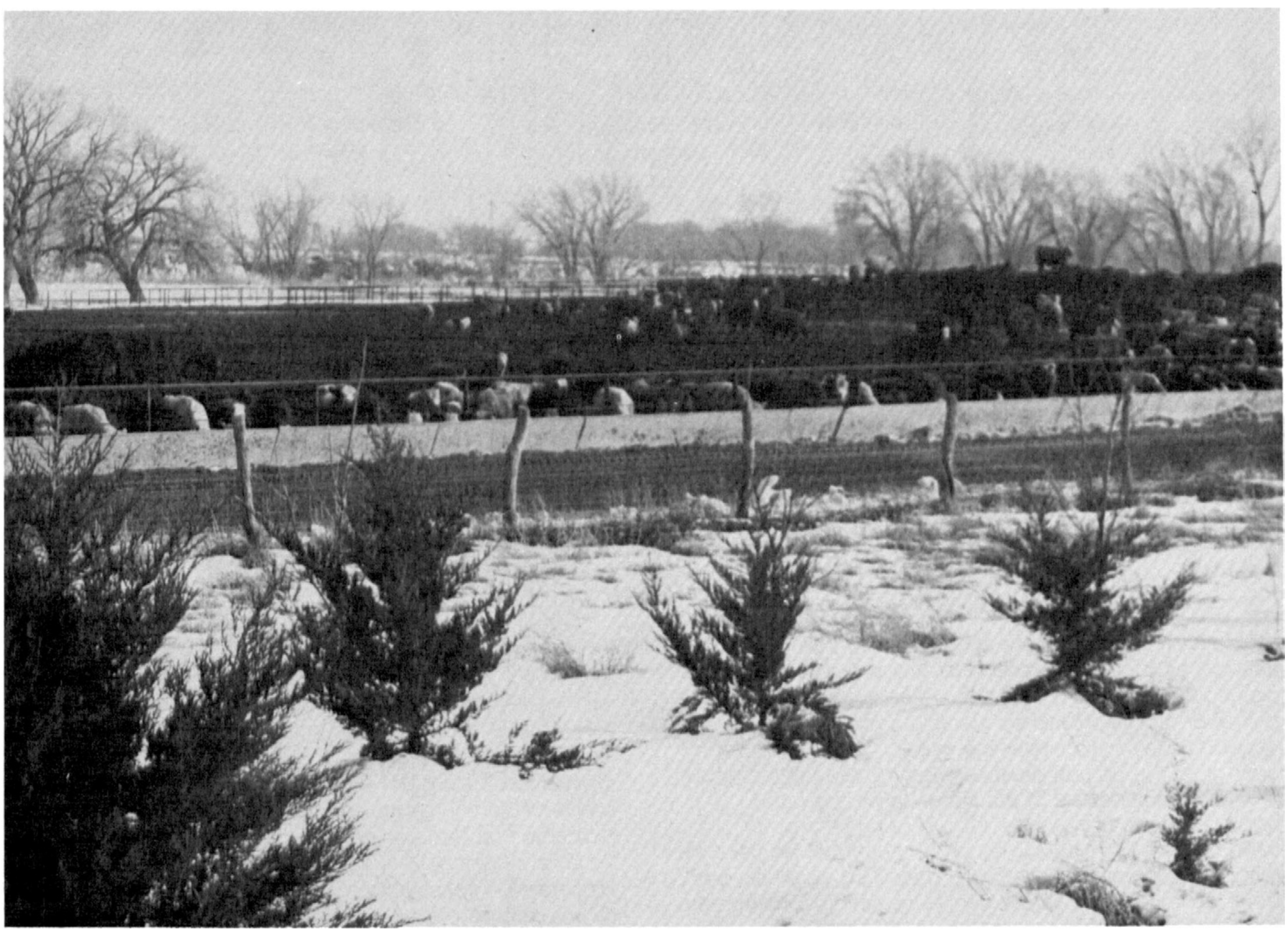

Figure 14.—Young eastern redcedars in a windbreak protecting a feedlot from snow and winds.

Figure 15.—A field windbreak providing cover for many wildlife species.

the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind

of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, grain sorghum, soybeans, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestems, switchgrass, indiangrass, goldenrod, beggarweed, ragweed, sunflowers, native legumes, wheatgrass, and gamagrass.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, cottonwood, sycamore, elm, hackberry, black walnut, willow, ash, and mulberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, plum, fragrant sumac, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are redcedar, pine, spruce, and juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are gooseberry, dogwood, blackberry, buckbrush, prairie rose, and sumac.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, cattails, saltgrass, prairie cordgrass, buttonbush, indigobush, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, ponds, and lakes.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include owls, hawks, wild turkey, thrushes, woodpeckers, squirrels, opossum, raccoon, and white-tailed deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, redwing blackbirds, muskrat, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include coyotes, badgers, jackrabbits, hawks, meadowlarks, and killdeer.

Technical assistance in planning wildlife areas and in determining the vegetation suitable for planting can be obtained from the local office of the Soil Conservation Service. Additional information and assistance can be obtained from local offices of the Kansas Fish and Game Commission and the Cooperative Extension Service.

Engineering

Glen Creager, Jr., civil engineer, Soil Conservation Service, helped prepare this section.

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the

most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating

and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Sanitary Facilities

Table 11 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The

soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

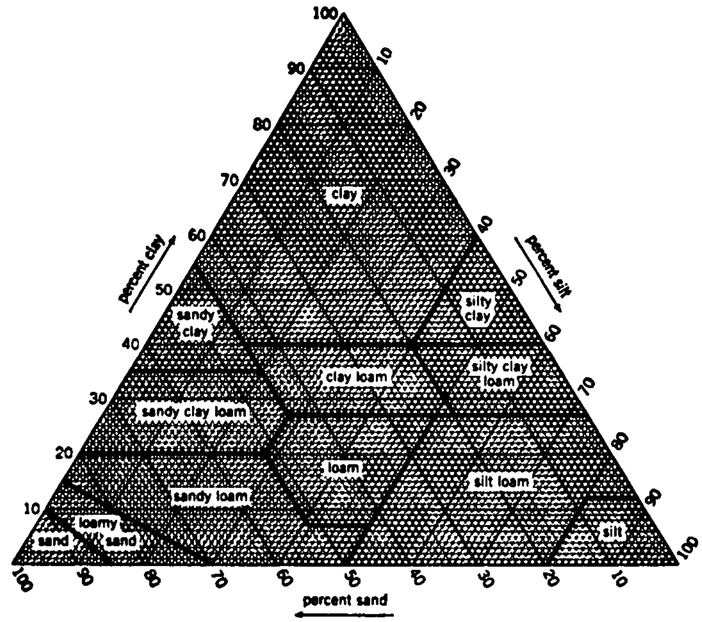

Figure 16.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 16). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of

grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

Physical and Chemical Properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in

place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 15, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist

chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16. Only saturated zones within a depth of about 6 feet are indicated.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*5*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 17 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustoll (*Ust*, meaning intermittent dryness, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Argiustolls (*Argi*, meaning argillic horizon, plus *ustoll*, the suborder of the Mollisols that have an ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Argiustolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine, montmorillonitic, mesic Typic Argiustolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*4*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*5*). Unless otherwise stated, matrix colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Armo Series

The Armo series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loamy colluvial sediments weathered from chalky limestone. Slope ranges from 3 to 15 percent.

Armo soils are similar to Wakeen soils and are commonly adjacent to Harney, Nibson, and Roxbury soils. Harney soils have a noncalcareous surface layer. They are in the less sloping areas below the Armo soils. Wakeen soils are moderately deep over chalky limestone and shale. They are higher on the landscape than the Armo soils. Nibson soils are shallow over chalky

limestone and shale. They are on side slopes above the Armo soils. Roxbury soils have a mollic epipedon that is more than 20 inches thick. They are on stream terraces and flood plains.

Typical pedon of Armo loam, 7 to 15 percent slopes, 1,500 feet east and 2,400 feet north of the southwest corner of sec. 36, T. 13 S., R. 10 W.

A—0 to 9 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; strong medium granular structure; slightly hard, friable; many fine roots; about 10 percent fragments of limestone 2 millimeters to 1 centimeter in size; strong effervescence; moderately alkaline; clear smooth boundary.

AB—9 to 14 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; many fine roots; about 10 percent fragments of limestone 2 millimeters to 1 centimeter in size; strong effervescence; moderately alkaline; gradual smooth boundary.

Bw—14 to 25 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; moderate fine subangular blocky structure; slightly hard, friable; few fine roots; about 10 percent fragments of limestone 2 millimeters to 1 centimeter in size; violent effervescence; moderately alkaline; gradual wavy boundary.

Bk—25 to 40 inches; very pale brown (10YR 8/3) clay loam, pale brown (10YR 6/3) moist; weak medium subangular blocky structure; hard, friable; few fragments of limestone and about 10 percent medium and coarse gravel; organic stains on faces of peds and in root channels; violent effervescence; moderately alkaline; diffuse wavy boundary.

C1—40 to 53 inches; very pale brown (10YR 8/3) gravelly clay loam, pale brown (10YR 6/3) moist; massive; hard, friable; about 25 percent mostly medium gravel, a few fine and coarse pebbles, and a few limestone cobbles; violent effervescence; moderately alkaline; clear wavy boundary.

C2—53 to 60 inches; very pale brown (10YR 7/4) gravelly loam, light yellowish brown (10YR 6/4) moist; massive; slightly hard, friable; about 35 percent fragments of limestone 2 millimeters to 1 centimeter in size; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 40 inches. The thickness of the mollic epipedon ranges from 7 to 18 inches. The soils typically contain lime throughout. They are mildly alkaline or moderately alkaline throughout.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 to 3. It is dominantly loam, but the range includes silt loam. The Bw horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is clay loam, silty clay loam, or loam. The C horizon has colors similar to those in the B horizon. It is silt loam, clay loam, gravelly clay loam, or gravelly loam. The content of limestone fragments 0.5 millimeter to 2.5 centimeters in diameter ranges from 15 to 30 percent.

Corinth Series

The Corinth series consists of moderately deep, well drained, slowly permeable soils on uplands. These soils formed in material weathered from calcareous, clayey shale. Slope ranges from 3 to 15 percent.

Corinth soils are commonly adjacent to Harney and Nibson soils. Harney soils are more than 40 inches deep over bedrock and are on slopes above the Corinth soils. Nibson soils are less than 20 inches deep over chalky limestone and shale. They typically are lower on the landscape than the Corinth soils.

Typical pedon of Corinth silty clay loam, 7 to 15 percent slopes, 2,450 feet south and 175 feet west of the northeast corner of sec. 3, T. 10 S., R. 9 W.

A—0 to 6 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; hard, firm; common fine and very fine roots; few limestone fragments; strong effervescence; mildly alkaline; clear smooth boundary.

Bw1—6 to 11 inches; pale brown (10YR 6/3) silty clay, brown (10YR 5/3) moist; moderate medium blocky structure; hard, firm; common fine roots; common limestone fragments; strong effervescence; mildly alkaline; gradual smooth boundary.

Bw2—11 to 30 inches; pale brown (10YR 6/3) silty clay, brown (10YR 5/3) moist; olive yellow (2.5Y 6/6) stains on a few faces of peds; moderate medium blocky structure; very hard, firm; few fine roots; common fine limestone fragments; few flat pieces of calcite; strong effervescence; moderately alkaline; gradual smooth boundary.

Cr—30 inches; light gray (10YR 6/1) and pale yellow (2.5Y 7/4) platy shale.

The thickness of the solum ranges from 15 to 30 inches. The depth to shale ranges from 20 to 40 inches. The soils contain lime throughout. They are mildly alkaline or moderately alkaline throughout.

The A horizon has hue of 10YR or 2.5Y, value of 5 or 6 (3 to 5 moist), and chroma of 2 to 4. The Bw horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 3 to 6. It is silty clay loam or silty clay.

Crete Series

The Crete series consists of deep, moderately well drained, slowly permeable soils on uplands. These soils formed in loess. Slope ranges from 0 to 2 percent.

Crete soils are similar to Detroit and Harney soils and are commonly adjacent to Harney soils. Their subsoil contains more clay than that of the similar soils. Detroit soils are on stream terraces. Harney soils have a mollic epipedon that is less than 20 inches thick. They are more sloping than the Crete soils and typically are lower on the landscape.

Typical pedon of Crete silt loam, 0 to 2 percent slopes, 2,050 feet south and 125 feet east of the northwest corner of sec. 36, T. 13 S., R. 10 W.

Ap—0 to 6 inches; dark gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) moist; weak fine granular structure; slightly hard, friable; common very fine roots; medium acid; clear smooth boundary.

AB—6 to 12 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark gray (10YR 3/1) moist; moderate medium granular structure; hard, firm; common very fine roots; neutral; clear smooth boundary.

Bt1—12 to 24 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate fine blocky structure; very hard, firm; few very fine roots; neutral; clear smooth boundary.

Bt2—24 to 32 inches; grayish brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; moderate medium blocky structure; very hard, very firm; few very fine roots; neutral; clear smooth boundary.

Bt3—32 to 40 inches; pale brown (10YR 6/3) silty clay, brown (10YR 4/3) moist; weak medium blocky structure; very hard, very firm; few fine lime concretions; few very fine roots; mildly alkaline; clear smooth boundary.

C—40 to 60 inches; very pale brown (10YR 7/3) silty clay loam, grayish brown (10YR 5/2) moist; few medium faint gray (10YR 5/1) and few fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; slightly hard, friable; few very fine roots; few fine very dark brown concretions; few fine lime concretions; moderately alkaline.

The thickness of the solum ranges from 30 to 48 inches. The mollic epipedon ranges from 20 to 36 inches in thickness. The depth to lime ranges from 25 to 40 inches.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly silt loam, but the range includes silty clay loam. The Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 or 3. The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is silt loam or silty clay loam.

Detroit Series

The Detroit series consists of deep, moderately well drained, slowly permeable soils on terraces. These soils formed in alluvium. Slope ranges from 0 to 2 percent.

Detroit soils are similar to Crete, Harney, and New Cambria soils and are commonly adjacent to Hord, New Cambria, and Roxbury soils. Crete soils contain more clay in the subsoil than the Detroit soils. They are on uplands. Harney soils have a mollic epipedon that is less than 20 inches thick. They are on uplands. New Cambria soils do not have an argillic horizon. They have lime at or near the surface. Hord soils contain less clay in the subsoil than the Detroit soils. Also, they are on slightly higher terraces. Roxbury soils have lime at or near the surface. They are on low terraces and flood plains.

Typical pedon of Detroit silty clay loam, 300 feet north and 100 feet west of the center of sec. 1, T. 11 S., R. 10 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable; few very fine roots; slightly acid; abrupt smooth boundary.

A—6 to 12 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; hard, friable; few very fine roots; slightly acid; clear smooth boundary.

Bt—12 to 31 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; very hard, firm; few very fine roots; neutral; gradual smooth boundary.

BC—31 to 60 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; hard, firm; slight effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 60 inches. The depth to lime ranges from 22 to 40 inches. The mollic epipedon is 20 to 30 inches thick.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is slightly acid or neutral. The Bt horizon has hue of 10YR, value of 3 to 5 (2 to 4 moist), and chroma of 2 or 3. It is silty clay loam or silty clay, and it is neutral or mildly alkaline.

Edalgo Series

The Edalgo series consists of moderately deep, well drained, very slowly permeable soils on uplands. These soils formed in material weathered from noncalcareous shale. Slope ranges from 3 to 7 percent.

Edalgo soils are commonly adjacent to Geary, Hedville, Lancaster, and Wells soils. Geary and Wells soils are more than 40 inches deep over bedrock. They are in positions on the landscape similar to those of the

Edalgo soils. Hedville soils are 4 to 20 inches deep over sandstone. Lancaster soils are 20 to 40 inches deep over sandstone or sandy shale. Hedville and Lancaster soils are higher on the landscape than Edalgo soils.

Typical pedon of Edalgo silt loam, in an area of Wells-Edalgo complex, 3 to 7 percent slopes, 2,000 feet north and 375 feet west of the southeast corner of sec. 20, T. 12 S., R. 7 W.

A—0 to 6 inches; brown (7.5YR 4/2) silt loam, dark brown (7.5YR 3/2) moist; moderate medium granular structure; slightly hard, friable; many fine and very fine roots; slightly acid; clear smooth boundary.

Bt1—6 to 18 inches; dark reddish gray (5YR 4/2) silty clay, dark reddish brown (5YR 3/2) moist; moderate fine blocky structure; very hard, firm; common fine and very fine roots; neutral; clear wavy boundary.

Bt2—18 to 29 inches; reddish brown (5YR 5/3) silty clay, reddish brown (5YR 4/3) moist; moderate medium blocky structure; very hard, firm; common very fine roots; neutral; clear wavy boundary.

BC—29 to 36 inches; reddish brown (10YR 5/3) and pink (5YR 7/4) silty clay, reddish brown (5YR 4/3) and pink (5YR 7/4) moist; moderate coarse subangular blocky structure; very hard, firm; few very fine roots between peds; few concretions of lime; mildly alkaline; clear smooth boundary.

Cr—36 inches; reddish brown (5YR 5/3) and pink (5YR 7/4) shale.

The solum is 18 to 36 inches thick. The depth to shale bedrock is 20 to 40 inches. The solum does not have lime, but the C horizon in most pedons has threads and concretions of lime.

The A horizon has hue of 7.5YR or 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly clay loam, but the range includes silt loam and loam. The Bt horizon has hue of 5YR to 2.5Y, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. It is silty clay, silty clay loam, or clay loam. The C horizon has hue of 5YR to 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 1 to 8. It is clay or silty clay.

Geary Series

The Geary series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in reddish brown loess. Slope ranges from 2 to 10 percent.

Geary soils are similar to Harney and Wells soils and are commonly adjacent to Edalgo, Harney, Lancaster, and Wells soils. The subsoil of Harney soils is grayer than that of the Geary soils. Wells soils contain more sand in the subsoil than the Geary soils. Edalgo and Lancaster soils are 20 to 40 inches deep over bedrock. They are on the higher side slopes.

Typical pedon of Geary silt loam, 2 to 7 percent slopes, 1,900 feet north and 400 feet east of the southwest corner of sec. 3, T. 12 S., R. 7 W.

A—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; slightly hard, friable; many fine roots; medium acid; gradual smooth boundary.

BA—9 to 15 inches; brown (7.5YR 4/2) silty clay loam, dark brown (7.5YR 3/2) moist; moderate fine subangular blocky structure; very hard, friable; common fine roots; medium acid; gradual smooth boundary.

Bt—15 to 29 inches; reddish brown (5YR 5/3) silty clay loam, reddish brown (5YR 4/3) moist; moderate medium subangular blocky structure; very hard, firm; common fine roots; slightly acid; gradual smooth boundary.

BC—29 to 42 inches; reddish brown (5YR 5/3) silty clay loam, reddish brown (5YR 4/3) moist; weak coarse subangular blocky structure; very hard, friable; few fine roots; neutral; gradual smooth boundary.

C—42 to 60 inches; reddish brown (5YR 5/3) silt loam, reddish brown (5YR 4/3) moist; massive; hard, friable; porous; mildly alkaline.

The thickness of the solum ranges from 30 to 50 inches. The mollic epipedon ranges from 10 to 20 inches in thickness.

The A horizon has hue of 7.5YR or 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 2 or 3. It is slightly acid or medium acid. The Bt and C horizons have hue of 7.5YR or 5YR, value of 5 to 7 (4 or 5 moist), and chroma of 3 to 6. They are silty clay loam or clay loam. In some pedons lime concretions are below a depth of 40 inches.

Harney Series

The Harney series consists of deep, well drained, moderately slowly permeable soils on uplands. These soils formed in loess. Slope ranges from 1 to 7 percent.

Harney soils are similar to Crete, Detroit, and Geary soils and are commonly adjacent to Crete and Geary soils. Crete soils contain more clay in the subsoil than the Harney soils. They have a mollic epipedon that is more than 20 inches thick. They are in the nearly level areas slightly higher on the landscape than the Harney soils. Detroit soils have a mollic epipedon that is more than 20 inches thick. They are on stream terraces. Geary soils are lower on the landscape than the Harney soils. Also, their subsoil contains less clay.

Typical pedon of Harney silt loam, 1 to 3 percent slopes, 950 feet south and 200 feet west of the northeast corner of sec. 4, T. 11 S., R. 8 W.

Ap—0 to 8 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate

fine granular structure; slightly hard, friable; common very fine roots; neutral; clear smooth boundary.

Bt1—8 to 16 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; hard, firm; neutral; clear smooth boundary.

Bt2—16 to 26 inches; brown (10YR 5/3) silty clay, dark brown (10YR 4/3) moist; moderate medium blocky structure; very hard, firm; mildly alkaline; clear smooth boundary.

Bk—26 to 53 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; hard, friable; common concretions and threads of lime; mildly alkaline; clear smooth boundary.

C—53 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable; slight effervescence; moderately alkaline.

The thickness of the solum ranges from 28 to 50 inches. The depth to lime ranges from 18 to 30 inches. The thickness of the mollic epipedon ranges from 10 to 20 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is silt loam or silty clay loam and is slightly acid or neutral. In most pedons the upper part of the Bt horizon is part of the mollic epipedon and has colors like those of the A horizon. The part of the Bt horizon below the mollic epipedon has hue of 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 2 or 3. It is silty clay or silty clay loam in which the content of clay is 35 to 42 percent. The Bt horizon is neutral to moderately alkaline. The C horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3. It is silt loam or silty clay loam.

Hedville Series

The Hedville series consists of shallow, somewhat excessively drained, moderately permeable soils on uplands. These soils formed in material weathered from noncalcareous sandstone. Slope ranges from 3 to 20 percent.

Hedville soils are commonly adjacent to Edalgo and Lancaster soils. Edalgo and Lancaster soils are 20 to 40 inches deep over bedrock. Edalgo soils are lower on the landscape than the Hedville soils. Lancaster soils are in positions on the landscape similar to those of the Hedville soils.

Typical pedon of Hedville stony loam, in an area of Lancaster-Hedville complex, 3 to 20 percent slopes, 2,250 feet west and 750 feet south of the northeast corner of sec. 10, T. 12 S., R. 7 W.

A—0 to 17 inches; grayish brown (10YR 5/2) stony loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; many fine roots; about 30 percent sandstone fragments 1/2 inch to 3 inches in diameter; neutral; clear smooth boundary.

R—17 inches; brown (10YR 5/3) and strong brown (7.5YR 5/6) sandstone.

The thickness of the solum and the depth to sandstone range from 4 to 20 inches. The content of sandstone fragments 1 inch to 15 inches in diameter ranges from 0 to 35 percent. The soils are medium acid to neutral throughout.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 to 3. In some pedons a thin B or C horizon is between the mollic epipedon and the bedrock. It has hue of 10YR, 7.5YR, or 5YR, value of 5 or 6 (4 or 5 moist), and chroma of 2 to 4.

Hord Series

The Hord series consists of deep, well drained, moderately permeable soils on stream terraces. These soils formed in silty alluvium. Slope ranges from 0 to 2 percent.

Hord soils are similar to McCook, Roxbury, and Tobin soils and are commonly adjacent to Detroit, McCook, New Cambria, and Roxbury soils. The calcareous McCook soils have a mollic epipedon that is 10 to 20 inches thick. Roxbury soils have lime within a depth of 15 inches. The occasionally flooded Tobin soils are on narrow flood plains along drainageways. Detroit and New Cambria soils are in slightly concave areas. Their subsoil is more clayey than that of the Hord soils.

Typical pedon of Hord silt loam, 500 feet east and 200 feet north of the southwest corner of sec. 20, T. 10 S., R. 9 W.

Ap—0 to 6 inches; dark gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) moist; weak fine granular structure; slightly hard, friable; few worm casts; many fine roots; slightly acid; abrupt smooth boundary.

A—6 to 12 inches; dark gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) moist; moderate fine granular structure; slightly hard, friable; neutral; few worm casts; many fine roots; clear smooth boundary.

Bw—12 to 26 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable; neutral; many fine roots; clear smooth boundary.

BC—26 to 40 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak fine subangular blocky; slightly hard, friable; few fine roots; mildly alkaline; gradual smooth boundary.

C—40 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; massive; slightly hard, friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 30 to 55 inches. The thickness of the mollic epipedon ranges from 20 to 40 inches. The depth to lime ranges from 24 to 48 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly silt loam, but the range includes silty clay loam. The Bw horizon has colors similar to those of the A horizon. The Bw horizon is silt loam or silty clay loam. The C horizon has hue of 10YR, value 4 to 7 (3 to 5 moist), and chroma of 2 or 3. It is typically silt loam, silty clay loam, or very fine sandy loam. It is mildly alkaline or moderately alkaline.

Lancaster Series

The Lancaster series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in material weathered from noncalcareous sandstone and sandy shale. Slope ranges from 3 to 10 percent.

Lancaster soils are similar to Wells soils and are commonly adjacent to Edalgo, Geary, Hedville, and Wells soils. Wells and Geary soils are more than 40 inches deep over bedrock. They are on side slopes below the Lancaster soils. Edalgo soils are 20 to 40 inches deep over shale. They are lower on the landscape than the Lancaster soils. Hedville soils are less than 20 inches deep over sandstone. They are in positions on the landscape similar to those of the Lancaster soils.

Typical pedon of Lancaster loam, in an area of Lancaster-Hedville complex, 3 to 20 percent slopes, 525 feet south and 2,550 feet west of the northeast corner of sec. 2, T. 12 S., R. 7 W.

A—0 to 10 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable; common fine roots; slightly acid; clear smooth boundary.

BA—10 to 16 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; moderate medium granular structure; slightly hard, friable; common very fine roots; slightly acid; gradual smooth boundary.

Bt1—16 to 25 inches; brown (7.5YR 5/4) clay loam, brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; very hard, firm; common very fine roots; few sandstone fragments less than 1 inch in diameter; neutral; gradual smooth boundary.

Bt2—25 to 31 inches; reddish yellow (7.5YR 6/6) sandy clay loam, strong brown (7.5YR 5/6) moist; moderate fine subangular blocky structure; hard, firm; few very fine roots; few fine sandstone fragments; neutral; gradual smooth boundary.

BC—31 to 36 inches; reddish yellow (7.5YR 6/6) fine sandy loam, strong brown (7.5YR 5/6) moist; massive, slightly hard, very friable; few fine roots; 10 percent sandstone fragments up to 1/2 inch in diameter; neutral; clear smooth boundary.

Cr—36 inches; sandy shale.

The thickness of the solum and the depth to sandy shale or sandstone range from 20 to 40 inches. The mollic epipedon ranges from 8 to 20 inches in thickness.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 to 3. It is loam, silt loam, or sandy loam. The Bt horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 to 6. It is clay loam or loam.

McCook Series

The McCook series consists of deep, well drained, moderately permeable soils on stream terraces. These soils formed in calcareous alluvium. Slope ranges from 0 to 2 percent.

McCook soils are similar to Hord, Roxbury, and Tobin soils and are commonly adjacent to Detroit, Hord, New Cambria, and Roxbury soils. Hord, Roxbury, and Tobin soils have a mollic epipedon that is more than 20 inches thick. Detroit and New Cambria soils are slightly lower on the landscape than the McCook soils. Also, their subsoil is more clayey.

Typical pedon of McCook silt loam, 1,150 feet east and 1,200 feet north of the southwest corner of sec. 11, T. 12 S., R. 9 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

A—6 to 14 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; soft, very friable; strong effervescence; moderately alkaline; clear smooth boundary.

AC—14 to 25 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; strong effervescence; moderately alkaline; gradual smooth boundary.

C—25 to 60 inches; light gray (10YR 7/2) very fine sandy loam, grayish brown (10YR 5/2) moist; massive; soft, very friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 16 to 30 inches. The mollic epipedon ranges from 10 to 20 inches in thickness. Most pedons are calcareous to the surface, but some do not have lime in the upper 10 inches. The

soils are mildly alkaline or moderately alkaline throughout.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly silt loam, but the range includes loam and fine sandy loam. The C horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3. It is silt loam or very fine sandy loam.

New Cambria Series

The New Cambria series consists of deep, moderately well drained, slowly permeable soils on stream terraces. These soils formed in calcareous, clayey alluvium. Slope ranges from 0 to 2 percent.

New Cambria soils are similar to Detroit soils and are commonly adjacent to Detroit, Hord, McCook, and Roxbury soils. Detroit soils have an argillic horizon and do not have lime in the surface layer. Hord, McCook, and Roxbury soils contain less clay in the subsoil than the New Cambria soils. Hord soils are slightly higher on terraces than the New Cambria soils. McCook and Roxbury soils are nearer to the stream channel than the New Cambria soils.

Typical pedon of New Cambria silty clay loam, occasionally flooded, 1,725 feet south and 100 feet west of the northeast corner of sec. 6, T. 12 S., R. 8 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; very hard, firm; strong effervescence; mildly alkaline; abrupt smooth boundary.

A—6 to 21 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; strong fine blocky structure; extremely hard, very firm; few worm casts; strong effervescence; moderately alkaline; diffuse smooth boundary.

Bw1—21 to 35 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate medium blocky structure; extremely hard, very firm; strong effervescence; moderately alkaline; gradual smooth boundary.

Bw2—35 to 48 inches; grayish brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; few fine faint yellowish brown (10YR 5/4) mottles in the lower part; moderate medium blocky and subangular blocky structure; extremely hard, very firm; many pores; few root channels coated with salts; strong effervescence; moderately alkaline; diffuse smooth boundary.

C—48 to 60 inches; light brownish gray (10YR 6/2) silty clay loam, grayish brown (10YR 5/2) moist; few fine faint yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; very hard, very firm; few fine pores; many root channels coated with salts; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 25 to 50 inches. The mollic epipedon is 20 to 40 inches thick. The soils are silty clay loam or silty clay throughout.

The A horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly silty clay loam, but the range includes silty clay. The Bw horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6 (4 or 5 moist), and chroma of 1 to 3.

Nibson Series

The Nibson series consists of shallow, somewhat excessively drained, moderately permeable soils on uplands. These soils formed in material weathered from interbedded chalky limestone and shale (fig. 17). Slope ranges from 5 to 25 percent.

Nibson soils are commonly adjacent to Armo, Harney, and Wakeen soils. Armo and Harney soils are more than 40 inches deep over bedrock. Armo soils are on foot slopes, and Harney soils are on ridgetops. Wakeen soils are 20 to 40 inches deep over bedrock. They are on the less sloping ridges above the Nibson soils.

Typical pedon of Nibson silt loam, in an area of Nibson-Wakeen silt loams, 5 to 25 percent slopes, 1,520 feet north and 75 feet east of the southwest corner of sec. 31, T. 10 S., R. 7 W.

A—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; common fine and very fine roots; few small limestone fragments; strong effervescence; moderately alkaline; clear smooth boundary.

Bw—7 to 14 inches; very pale brown (10YR 7/3) silty clay loam, brown (10YR 5/3) moist; strong medium granular structure; slightly hard, friable; common fine and very fine roots; few limestone fragments; strong effervescence; moderately alkaline; clear smooth boundary.

BC—14 to 19 inches; very pale brown (10YR 7/4) silty clay loam, light yellowish brown (10YR 6/4) moist; weak fine subangular blocky structure; slightly hard, friable; few very fine roots; violent effervescence; moderately alkaline; clear smooth boundary.

Cr—19 inches; white (10YR 8/2) shale and chalky limestone.

The thickness of the solum ranges from 10 to 15 inches. The depth to chalky shale or soft limestone ranges from 10 to 20 inches. The thickness of the mollic epipedon ranges from 7 to 10 inches.

The A horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. The Bw horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is silt loam or silty clay loam.

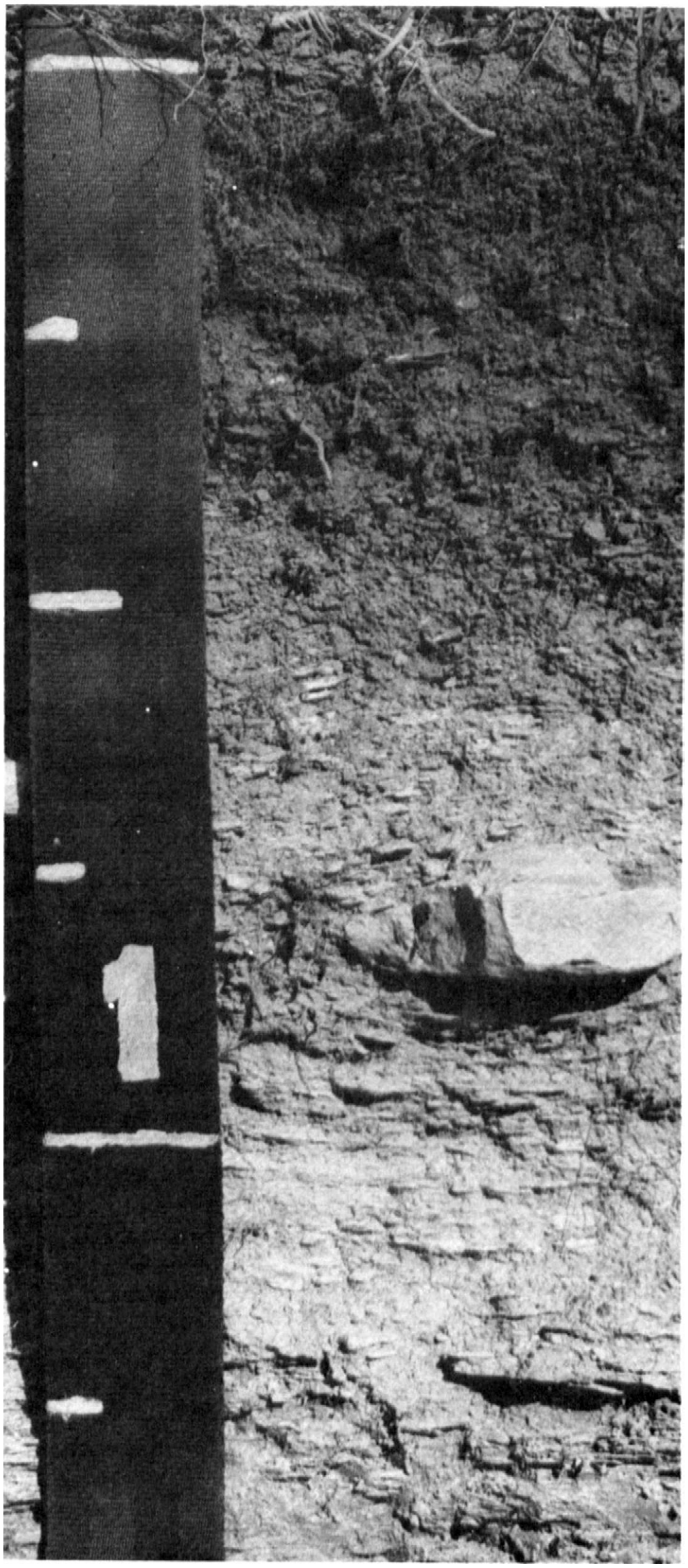

Figure 17.—Profile of Nibson silt loam. Nibson soils are shallow over chalky limestone and shale. Depth is marked in feet.

Roxbury Series

The Roxbury series consists of deep, well drained, moderately permeable soils on terraces and flood plains. These soils formed in calcareous alluvium. Slope ranges from 0 to 2 percent.

Roxbury soils are similar to Hord, McCook, and Tobin soils and are commonly adjacent to Detroit, Hord, McCook, and New Cambria soils. Hord and Tobin soils do not have lime in the upper 15 inches. McCook soils have a mollic epipedon that is less than 20 inches thick. Detroit and New Cambria soils contain more clay in the subsoil than the Roxbury soils. Also, they are slightly lower on terraces.

Typical pedon of Roxbury silt loam, 1,000 feet north and 200 feet west of the southeast corner of sec. 25, T. 11 S., R. 9 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; soft, friable; common very fine roots; numerous worm holes and casts; strong effervescence; mildly alkaline; clear smooth boundary.

A—6 to 14 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; few very fine roots; numerous worm holes and casts; strong effervescence; moderately alkaline; clear smooth boundary.

Bw—14 to 28 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable; few very fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

BC—28 to 52 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; hard, friable; few thin strata of slightly darker material; few root channels coated with salts; strong effervescence; moderately alkaline; gradual smooth boundary.

C—52 to 60 inches; brown (10YR 5/3) silt loam, brown (10YR 4/3) moist; massive; hard, friable; root channels filled with salts; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 60 inches. The mollic epipedon is more than 20 inches thick. The depth to lime is less than 15 inches. The soils are mildly alkaline or moderately alkaline throughout.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly silt loam, but the range includes loam and silty clay loam. The Bw horizon has hue of 10YR, value of 4 to 6 (2 to 4 moist), and chroma of 1 or 2. It is silt loam or silty clay loam. The C horizon has hue of 10YR, value of 5 to 7 (4 or 5

moist), and chroma of 2 or 3. It is silt loam, silty clay loam, or loam. In some pedons the C horizon has thin strata of more clayey or more sandy material.

Saltine Series

The Saltine series consists of deep, somewhat poorly drained, slowly permeable, saline-alkali soils on flood plains. These soils formed in calcareous, silty alluvium. Slope is 0 to 1 percent.

The surface soil of the Saltine soils in this county is thicker and darker than is defined as the range for the Saltine series. This difference, however, does not alter the use or behavior of the soils.

Saltine soils are commonly adjacent to New Cambria and Roxbury soils. New Cambria and Roxbury soils are neither saline nor sodic. They are slightly higher on the landscape than the Saltine soils.

Typical pedon of Saltine silty clay loam, frequently flooded, 150 feet south and 100 feet west of the northeast corner of sec. 12, T. 10 S., R. 8 W.

A1—0 to 12 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; hard, friable; slight effervescence; moderately alkaline; about 34 percent exchangeable sodium; slightly saline; clear smooth boundary.

A2—12 to 22 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, firm; strong effervescence; moderately alkaline; about 27 percent exchangeable sodium; slightly saline; clear smooth boundary.

C1—22 to 45 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; massive; hard, firm; strong effervescence; strongly alkaline; about 25 percent exchangeable sodium; slightly saline; abrupt smooth boundary.

C2—45 to 60 inches; pale brown (10YR 6/3) silty clay loam, grayish brown (10YR 5/2) moist; few fine distinct yellowish brown (10YR 5/4) mottles; massive; hard, firm; strong effervescence; strongly alkaline; about 26 percent exchangeable sodium; slightly saline.

The thickness of the solum ranges from 16 to 30 inches. The soils are strongly affected by excess sodium in the solum.

The A horizon has hue of 10YR, value of 4 to 6 (2 or 3 moist), and chroma of 1 or 2. It ranges from mildly alkaline to strongly alkaline. It is dominantly silty clay loam, but the range includes silt loam. The C horizon has hue of 10YR, value of 5 or 6 (3 to 5 moist), and chroma of 1 to 3. Some pedons have buried soils or dark layers and stratified sediments.

Tobin Series

The Tobin series consists of deep, well drained, moderately permeable soils on narrow flood plains. These soils formed in stratified, silty alluvium. Slope ranges from 0 to 2 percent.

Tobin soils are similar to Hord, McCook, and Roxbury soils and are commonly adjacent to Geary, Harney, and Hord soils. Hord soils are subject to rare flooding and are on terraces. McCook soils have a mollic epipedon that is less than 20 inches thick. Roxbury soils contain lime within a depth of 15 inches. The subsoil of Geary soils is browner than that of the Tobin soils. The subsoil of Harney soils contains more clay than that of the Tobin soils. Geary and Harney soils are on uplands.

Typical pedon of Tobin silt loam, occasionally flooded, 2,200 feet west and 200 feet south of the northeast corner of sec. 8, T. 13 S., R. 6 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

A—8 to 30 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; slightly hard, friable; neutral; clear smooth boundary.

AC—30 to 45 inches; dark grayish brown (10YR 4/2) silt loam, finely stratified with slightly darker colors; very dark grayish brown (10YR 3/2) moist; massive; hard, friable; few fine accumulations of lime below a depth of 38 inches; mildly alkaline; gradual smooth boundary.

C—45 to 60 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; massive; hard, friable; few fine accumulations of lime; mildly alkaline.

The thickness of the solum ranges from 20 to 50 inches. The mollic epipedon is more than 20 inches thick. The depth to lime ranges from 15 to 40 inches. The solum is silt loam or silty clay loam.

The A horizon has hue of 7.5YR to 2.5Y, value of 4 or 5 (2 or 3 moist), and chroma of 1 to 3. It is medium acid to mildly alkaline. The AC horizon has the same color range as the A horizon. It is slightly acid to moderately alkaline. The C horizon has hue of 7.5YR to 2.5Y, value of 4 to 7 (2 to 5 moist), and chroma of 1 to 4. It is mildly alkaline or moderately alkaline. In some pedons contrasting strata which contain more sand or more clay are below a depth of 40 inches. A few pedons have mottles.

Wakeen Series

The Wakeen series consists of moderately deep, well drained, moderately permeable soils on uplands. These

soils formed in material weathered from chalky limestone and shale. Slope ranges from 1 to 20 percent.

Wakeen soils are similar to Armo soils and are commonly adjacent to Armo, Corinth, Harney, and Nibson soils. Armo soils are more than 40 inches deep over bedrock and are on foot slopes. Corinth soils do not have a mollic epipedon and are higher on the landscape than the Wakeen soils. Harney soils are more than 40 inches deep over bedrock. They are higher on the landscape than the Wakeen soils. Nibson soils are less than 20 inches deep over chalky limestone and shale. They are on the lower side slopes.

Typical pedon of Wakeen silt loam, in an area of Harney-Wakeen complex, 2 to 7 percent slopes, 2,450 feet south and 175 feet west of the northeast corner of sec. 10, T. 11 S., R. 7 W.

A—0 to 11 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; hard, friable; common very fine roots; slight effervescence; moderately alkaline; clear smooth boundary.

Bw1—11 to 19 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate medium and coarse subangular blocky structure; hard, firm; few very fine roots; few fine threads and coatings of lime in the lower part; slight effervescence; moderately alkaline; clear smooth boundary.

Bw2—19 to 35 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; hard, firm; few very fine roots; few small limestone fragments; strong effervescence; moderately alkaline; gradual wavy boundary.

Cr—35 inches; very pale brown (10YR 8/3) chalky limestone.

The thickness of the solum and the depth to chalky limestone or shale range from 20 to 40 inches. The mollic epipedon ranges from 7 to 20 inches in thickness. The soils contain lime throughout. They are mildly alkaline or moderately alkaline throughout.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. The Bw horizon has hue of 10YR, value of 5 to 8 (3 to 6 moist), and chroma of 2 to 6. It is silty clay loam or silt loam.

Wells Series

The Wells series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in old alluvium modified by deposits of colluvium and loess. Slope ranges from 3 to 7 percent.

Wells soils are similar to Geary and Lancaster soils and are commonly adjacent to Geary, Harney, and Lancaster soils. The subsoil of Geary soils contains less sand than that of the Wells soils. Lancaster soils are 20 to 40 inches deep over sandy shale or sandstone. Harney soils contain less sand and more clay in the subsoil than the Wells soils. Also, they are higher on the landscape.

Typical pedon of Wells loam, in an area of Wells-Edalgo complex, 3 to 7 percent slopes, 1,000 feet west and 200 feet south of the northeast corner of sec. 12, T. 11 S., R. 6 W.

Ap—0 to 6 inches; brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; slightly hard, friable; common fine roots; slightly acid; abrupt smooth boundary.

AB—6 to 13 inches; brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; slightly hard, friable; common fine roots; neutral; gradual smooth boundary.

Bt—13 to 36 inches; reddish brown (5YR 5/3) clay loam, reddish brown (5YR 4/3) moist; moderate medium subangular blocky structure; hard, firm; few very fine roots; neutral; abrupt smooth boundary.

BC—36 to 52 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; hard, friable; neutral; gradual smooth boundary.

C—52 to 60 inches; reddish yellow (5YR 6/6) sandy loam, yellowish red (5YR 5/6) moist; massive; slightly hard, friable; neutral.

The thickness of the solum ranges from 35 to 55 inches. The thickness of the mollic epipedon ranges from 10 to 20 inches. The depth to bedrock ranges from 40 to more than 60 inches.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is slightly acid or medium acid. The Bt horizon has hue of 7.5YR or 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 or 4. It is slightly acid or neutral. The C horizon has hue of 7.5YR or 5YR, value of 5 to 7 (5 or 6 moist), and chroma of 4 to 8. It is clay loam, sandy clay loam, or sandy loam. It is slightly acid or neutral. In some pedons lime is below a depth of 40 inches.

Formation of the Soils

The characteristics of a soil at any given place are determined by the interaction among five factors of soil formation—climate, plants and other living organisms, parent material, relief, and time. Each of these factors affects the formation of every soil, and each modifies the effects of the other four. The effects of the individual factors vary from place to place. The interactions among the factors are more complex for some soils than for others.

Climate and vegetation act on the parent material and gradually change it to a natural body of soil. Relief modifies the effects of climate and vegetation, mainly through its effect on runoff and temperature. The nature of the parent material helps to determine the kind of soil that forms. Time is needed for changing the parent material into a soil. Generally, a long period is needed for the formation of distinct horizons.

Parent Material

Parent material is the weathered rock or partly weathered material in which soils form. It affects the texture, structure, color, natural fertility, and many other properties of the soil. The soils in Lincoln County formed in alluvium, colluvium, loess, and residuum of chalky limestone, shale, or sandstone.

Alluvium is sediment deposited by floodwater in stream valleys. In the valley of the Saline River, it ranges from silty to clayey. In the smaller valleys the sediment generally is silty and of local origin. Detroit, McCook, Roxbury, and Tobin soils formed in alluvial material.

The colluvium in Lincoln County is loamy sediment that accumulated at the base of the steeper slopes as a result of gravity. It is derived from chalky shale and limestone bedrock. Armo soils formed in colluvial material.

Loess is silty wind-deposited material, some of which has been carried hundreds of miles from its source. Peorian Loess of the Wisconsin Glaciation was deposited during the Pleistocene epoch. It covers many of the uplands in the county. In most areas it is very pale brown or light gray, calcareous, and friable. Crete and Harney soils formed in this material. Loveland Loess is the parent material of Geary soils. This reddish brown material was deposited during Illinoian time.

The bedrock that crops out in the county is chalky limestone, shale, or sandstone. The chalky limestone and shale are part of the Upper Cretaceous System. The calcareous Corinth, Nibson, and Wakeen soils formed in residuum of the chalky bedrock. Edalgo, Hedville, and Lancaster soils formed in material weathered from shale or sandstone of the Dakota Formation in the Lower Cretaceous System.

Climate

Climate affects physical and chemical weathering and the biological forces at work in the parent material. Soil-forming processes are most active when the soil is warm and moist.

The climate in Lincoln County is continental. It is characterized by intermittent dry and moist periods, which can last for less than a year or for several years. The soil material dries to varying depths during dry periods. It slowly regains moisture during wet periods and can become saturated with excess moisture. The accumulation of lime in the lower part of the subsoil in Harney soils is an indication of this excess moisture. The downward movement of water is of major importance in transforming the parent material into a soil that has distinct horizons.

Climate is an important factor affecting soil formation throughout a wide region, but it does not significantly differentiate soils in a small area, such as a survey area.

Plant and Animal Life

Plants generally affect the content of plant nutrients and organic matter in the soil and the color of the surface layer. Bacteria and fungi help to decompose the plants, thus releasing more nutrients. Earthworms, cicadas, and burrowing animals help to keep the soil open and porous.

The mid and tall prairie grasses have had a significant effect on soil formation in Lincoln County. As a result of the grasses, the upper part of a typical soil in the county is dark and is high in content of organic matter. In many areas the next part of the soil is slightly finer textured and somewhat lighter colored than the layer above. The underlying parent material generally is light in color and high in content of lime.

Human activities, such as farming and ranching, greatly affect soil formation. In many areas in the county, they have increased the susceptibility to erosion and increased or decreased the content of organic matter.

Also, land leveling and industrial or urban development have altered the relief.

Relief

Relief affects soil formation through its effect on drainage, runoff, plant cover, and soil temperature. Most important is the effect of relief on the movement of water on the surface and into the soil.

Runoff is more rapid on the steeper soils in the uplands than on the less sloping soils. As a result, erosion is more extensive. Relief has retarded the formation of Hedville soils, which formed in the oldest parent material in the county. Runoff is rapid on these moderately sloping to moderately steep soils, and much of the soil material is removed as soon as the soil forms.

Time

The length of time needed for soil formation depends mainly on the other factors of soil formation. As water moves downward through the soil, soluble matter and fine particles are leached gradually from the surface layer and are deposited in the subsoil. The extent of leaching depends not only on the amount of water that has penetrated the surface but also on the amount of time that has elapsed.

Some of the soils in the county are young. McCook soils, which formed in recent alluvium, are an example. They show very little evidence of horizon differentiation other than a slight darkening of the surface layer. The older soils have well defined horizons. Crete soils, which have been forming for thousands of years, are an example.

References

(1) American Association of State Highway —and Transportation Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 vols., illus.

(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) Kansas State Board of Agriculture. 1981. 1980-1981 farm facts. Spec. Rep. Kans. Crop and Kans. Cattle Mark. Stat., 276 pp., illus.

(4) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus.

(5) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

Glossary

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:
Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.
Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.
Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.
Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.
Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.
Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.
Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.
Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.
Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess alkali (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as

contrasted with percolation, which is movement of water through soil layers or material.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Mollic epipedon. A thick, dark, humus-rich surface soil which also may be part of the subsoil. It has a high base saturation and a relatively soft consistency.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of

species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multipled by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of Na^{+} to $Ca^{++} + Mg^{++}$. The degrees of sodicity are—

	SAR
Slight	less than 13:1
Moderate	13-30:1
Strong	more than 30:1

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive*

(the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. Includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

Month	Temperature					Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	In	In	In		In
January----	41.8	17.0	29.4	70	-14	0.53	0.11	0.90	2	4.5
February---	47.6	21.8	34.7	80	- 8	.83	.10	1.65	2	5.6
March------	55.8	28.3	42.1	85	0	1.41	.35	2.24	4	5.4
April------	69.4	41.3	55.4	92	18	2.33	.88	3.77	5	1.1
May--------	78.3	51.8	65.1	98	29	3.79	1.78	6.13	7	---
June-------	88.5	62.0	75.3	106	44	4.30	2.10	5.72	6	---
July-------	94.5	66.9	80.7	110	49	3.48	1.36	5.38	6	---
August-----	94.0	65.9	80.0	110	47	3.01	1.17	4.16	5	---
September--	84.4	56.0	70.2	105	34	3.50	1.51	5.18	5	---
October----	73.6	44.3	59.0	95	22	2.00	.35	3.86	3	0.4
November---	56.8	29.8	43.3	79	1	.79	.08	2.06	2	2.3
December---	44.7	20.5	32.6	70	- 8	.78	.18	1.28	2	3.8
Year-----	69.1	42.1	55.6	111	-15	26.75	20.22	34.03	49	23.1

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Minimum temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 13	April 23	May 7
2 years in 10 later than--	April 8	April 18	May 2
5 years in 10 later than--	March 30	April 8	April 22
First freezing temperature in fall:			
1 year in 10 earlier than--	October 23	October 14	October 5
2 years in 10 earlier than--	October 27	October 19	October 9
5 years in 10 earlier than--	November 6	October 28	October 19

TABLE 3.--GROWING SEASON

Probability	Length of growing season if daily minimum temperature is--		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	203	185	159
8 years in 10	209	191	166
5 years in 10	221	203	180
2 years in 10	233	215	194
1 year in 10	239	221	201

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Am	Armo loam, 3 to 7 percent slopes	18,000	3.9
Ar	Armo loam, 7 to 15 percent slopes	36,500	7.9
Cn	Corinth silty clay loam, 3 to 7 percent slopes	700	0.2
Co	Corinth silty clay loam, 7 to 15 percent slopes	400	0.1
Cr	Crete silt loam, 0 to 2 percent slopes	2,800	0.6
De	Detroit silty clay loam	4,350	0.9
Gc	Geary silt loam, 2 to 7 percent slopes	30,150	6.5
Gh	Geary-Lancaster complex, 5 to 10 percent slopes	42,000	9.1
Hb	Harney silt loam, 1 to 3 percent slopes	73,300	16.0
Hc	Harney silty clay loam, 3 to 7 percent slopes	12,900	2.8
Hf	Harney-Wakeen complex, 2 to 7 percent slopes	35,450	7.7
Ho	Hord silt loam	10,560	2.3
Lh	Lancaster-Hedville complex, 3 to 20 percent slopes	42,100	9.1
Mc	McCook silt loam	6,000	1.3
Nc	New Cambria silty clay loam, occasionally flooded	17,500	3.8
Ns	Nibson-Wakeen silt loams, 5 to 25 percent slopes	50,829	11.0
Pt	Pits, quarries	750	0.2
Rb	Roxbury silt loam	15,050	3.3
Rc	Roxbury silt loam, channeled	2,000	0.4
Rf	Roxbury silt loam, occasionally flooded	25,600	5.5
Sa	Saltine silty clay loam, frequently flooded	950	0.2
To	Tobin silt loam, occasionally flooded	10,300	2.2
Wg	Wells-Edalgo complex, 3 to 7 percent slopes	23,000	5.0
	Water	104	*
	Total	461,293	100.0

* Less than 0.1 percent.

TABLE 5.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Land capability	Grain sorghum	Winter wheat	Alfalfa hay
		Bu	Bu	Tons
Am----------------------- Armo	IIIe	48	32	---
Ar----------------------- Armo	VIe	---	---	---
Cn----------------------- Corinth	IVe	36	26	1.5
Co----------------------- Corinth	VIe	---	---	---
Cr----------------------- Crete	IIs	55	38	3.2
De----------------------- Detroit	I	60	40	4.0
Gc----------------------- Geary	IIIe	52	33	3.6
Gh----------------------- Geary-Lancaster	IVe	50	31	3.0
Hb----------------------- Harney	IIe	54	36	2.8
Hc----------------------- Harney	IIIe	50	34	2.5
Hf----------------------- Harney-Wakeen	IVe	48	30	2.5
Ho----------------------- Hord	I	60	40	4.2
Lh----------------------- Lancaster-Hedville	VIe	---	---	---
Mc----------------------- McCook	I	60	40	3.5
Nc----------------------- New Cambria	IIw	56	36	4.0
Ns----------------------- Nibson-Wakeen	VIe	---	---	---
Pt*. Pits				
Rb----------------------- Roxbury	I	60	40	4.2
Rc----------------------- Roxbury	Vw	---	---	---
Rf----------------------- Roxbury	IIw	56	36	3.7
Sa----------------------- Saltine	VIs	---	---	---

See footnote at end of table.

TABLE 5.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability	Grain sorghum	Winter wheat	Alfalfa hay
		Bu	Bu	Tons
To-------------------------- Tobin	IIw	56	36	3.7
Wg-------------------------- Wells-Edalgo	IVe	48	28	3.0

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Am, Ar: Armo	Limy Upland	Favorable	4,500	Big bluestem	40
		Normal	3,000	Little bluestem	20
		Unfavorable	2,000	Sideoats grama	10
				Indiangrass	5
				Switchgrass	5
				Leadplant	5
				Western wheatgrass	5
Cn, Co: Corinth	Limy Upland	Favorable	4;500	Big bluestem	40
		Normal	2,500	Little bluestem	20
		Unfavorable	2,000	Sideoats grama	10
				Switchgrass	5
				Indiangrass	5
				Western wheatgrass	5
				Leadplant	5
Cr: Crete	Clay Upland	Favorable	5,000	Big bluestem	30
		Normal	3,500	Little bluestem	20
		Unfavorable	3,000	Switchgrass	10
				Sideoats grama	10
				Indiangrass	5
				Western wheatgrass	5
				Tall dropseed	5
				Blue grama	5
De: Detroit	Loamy Terrace	Favorable	6,000	Big bluestem	35
		Normal	4,500	Indiangrass	15
		Unfavorable	3,000	Little bluestem	10
				Switchgrass	10
				Western wheatgrass	5
				Sideoats grama	5
Gc: Geary	Loamy Upland	Favorable	5,500	Big bluestem	35
		Normal	4,000	Little bluestem	20
		Unfavorable	2,500	Indiangrass	10
				Switchgrass	10
				Tall dropseed	5
				Sideoats grama	5
Gh*: Geary	Loamy Upland	Favorable	5,500	Big bluestem	35
		Normal	4,000	Little bluestem	20
		Unfavorable	2,500	Indiangrass	10
				Switchgrass	10
				Tall dropseed	5
				Sideoats grama	5
Lancaster	Loamy Upland	Favorable	5,000	Big bluestem	30
		Normal	3,500	Little bluestem	25
		Unfavorable	2,000	Indiangrass	10
				Switchgrass	10
				Sideoats grama	5
Hb, Hc: Harney	Loamy Upland	Favorable	5,000	Big bluestem	30
		Normal	3,500	Little bluestem	20
		Unfavorable	2,000	Sideoats grama	10
				Western wheatgrass	10
				Blue grama	5
				Indiangrass	5
Hf*: Harney	Loamy Upland	Favorable	5,000	Big bluestem	30
		Normal	3,500	Little bluestem	20
		Unfavorable	2,000	Sideoats grama	10
				Western wheatgrass	10
				Blue grama	5
				Indiangrass	5

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Hf*:					
Wakeen	Limy Upland	Favorable	4,500	Big bluestem	35
		Normal	2,500	Little bluestem	20
		Unfavorable	2,000	Sideoats grama	15
				Switchgrass	5
				Blue grama	5
Ho	Loamy Terrace	Favorable	6,000	Big bluestem	35
Hord		Normal	4,500	Indiangrass	15
		Unfavorable	3,000	Little bluestem	10
				Switchgrass	10
				Western wheatgrass	5
				Sideoats grama	5
				Blue grama	5
Lh*:					
Lancaster	Loamy Upland	Favorable	5,000	Big bluestem	30
		Normal	3,500	Little bluestem	25
		Unfavorable	2,000	Indiangrass	10
				Switchgrass	10
				Sideoats grama	5
Hedville	Shallow Sandstone	Favorable	4,000	Little bluestem	35
		Normal	2,500	Big bluestem	30
		Unfavorable	1,500	Switchgrass	5
				Indiangrass	5
				Sideoats grama	5
Mc	Loamy Terrace	Favorable	6,000	Big bluestem	35
McCook		Normal	4,500	Indiangrass	15
		Unfavorable	3,000	Little bluestem	10
				Needleandthread	10
				Switchgrass	10
				Sideoats grama	5
				Western wheatgrass	5
Nc	Clay Lowland	Favorable	6,500	Big bluestem	35
New Cambria		Normal	5,000	Indiangrass	15
		Unfavorable	3,000	Switchgrass	10
				Prairie cordgrass	10
				Little bluestem	5
				Sideoats grama	5
				Western wheatgrass	5
Ns*:					
Nibson	Limy Upland	Favorable	4,500	Big bluestem	35
		Normal	2,500	Little bluestem	20
		Unfavorable	1,500	Sideoats grama	15
				Indiangrass	5
				Blue grama	5
				Western wheatgrass	5
Wakeen	Limy Upland	Favorable	4,500	Big bluestem	35
		Normal	2,500	Little bluestem	20
		Unfavorable	2,000	Sideoats grama	15
				Switchgrass	5
				Blue grama	5
Rb	Loamy Terrace	Favorable	6,000	Big bluestem	35
Roxbury		Normal	4,500	Indiangrass	15
		Unfavorable	3,000	Switchgrass	10
				Little bluestem	10
				Sideoats grama	5
				Western wheatgrass	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
Rc, Rf: Roxbury	Loamy Lowland	Favorable	6,500	Big bluestem	40
		Normal	5,500	Switchgrass	15
		Unfavorable	4,000	Indiangrass	10
				Western wheatgrass	5
				Little bluestem	5
				Prairie cordgrass	5
				Eastern gamagrass	5
Sa: Saltine	Saline Subirrigated	Favorable	7,000	Prairie cordgrass	30
		Normal	6,500	Inland saltgrass	20
		Unfavorable	6,000	Western wheatgrass	15
				Switchgrass	10
				Indiangrass	10
				Sedge	5
To: Tobin	Loamy Lowland	Favorable	6,500	Big bluestem	40
		Normal	5,500	Switchgrass	15
		Unfavorable	4,000	Indiangrass	10
				Little bluestem	5
				Western wheatgrass	5
				Prairie cordgrass	5
				Eastern gamagrass	5
Wg*:					
Wells	Loamy Upland	Favorable	5,500	Big bluestem	30
		Normal	4,000	Little bluestem	20
		Unfavorable	2,500	Indiangrass	10
				Switchgrass	10
				Sideoats grama	5
				Tall dropseed	5
Edalgo	Clay Upland	Favorable	4,500	Big bluestem	25
		Normal	3,000	Little bluestem	15
		Unfavorable	2,000	Switchgrass	10
				Sideoats grama	10
				Indiangrass	5
				Tall dropseed	5
				Western wheatgrass	5
				Blue grama	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Am, Ar: Armo	Fragrant sumac, Siberian peashrub, silver buffaloberry, Tatarian honeysuckle.	Eastern redcedar, bur oak, Russian-olive, Rocky Mountain juniper.	Ponderosa pine, honeylocust, green ash, Siberian elm.	---	---
Cn, Co: Corinth	Fragrant sumac, Tatarian honeysuckle, Siberian peashrub, silver buffaloberry.	Eastern redcedar, Russian-olive, Rocky Mountain juniper, bur oak.	Siberian elm, honeylocust, green ash, ponderosa pine.	---	---
Cr: Crete	Amur honeysuckle, Peking cotoneaster, Siberian peashrub.	Eastern redcedar, Rocky Mountain juniper, hackberry.	Austrian pine, green ash, honeylocust, Russian-olive, Russian mulberry.	Siberian elm	---
De: Detroit	American plum	Amur honeysuckle, lilac.	Eastern redcedar, Austrian pine, Russian-olive, ponderosa pine, green ash, Russian mulberry.	Hackberry, honeylocust.	Eastern cottonwood.
Gc: Geary	Peking cotoneaster	Lilac, fragrant sumac, Amur honeysuckle.	Eastern redcedar, hackberry, bur oak, green ash, Russian-olive.	Scotch pine, Austrian pine, honeylocust.	---
Gh*:					
Geary	Peking cotoneaster	Lilac, fragrant sumac, Amur honeysuckle.	Eastern redcedar, hackberry, bur oak, green ash, Russian-olive.	Scotch pine, Austrian pine, honeylocust.	---
Lancaster	Fragrant sumac, lilac, Siberian peashrub.	Rocky Mountain juniper, Russian mulberry, Russian-olive.	Eastern redcedar, green ash, Austrian pine, bur oak, honeylocust.	Siberian elm	---
Hb, Hc: Harney	Amur honeysuckle, lilac, fragrant sumac.	Russian mulberry	Eastern redcedar, bur oak, honeylocust, Russian-olive, Austrian pine, green ash, hackberry.	Siberian elm	---
Hf*:					
Harney	Amur honeysuckle, lilac, fragrant sumac.	Russian mulberry	Eastern redcedar, bur oak, honeylocust, Russian-olive, Austrian pine, green ash, hackberry.	Siberian elm	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Hf*: Wakeen	Siberian peashrub, fragrant sumac, silver buffaloberry, Tatarian honeysuckle.	Eastern redcedar, Russian-olive, Rocky Mountain juniper, bur oak.	Honeylocust, Siberian elm, ponderosa pine, green ash.	---	---
Ho: Hord	Peking cotoneaster	Lilac, Siberian peashrub, American plum.	Eastern redcedar, ponderosa pine, blue spruce, Manchurian crabapple.	Golden willow, green ash, hackberry.	Eastern cottonwood.
Lh*: Lancaster	Fragrant sumac, lilac, Siberian peashrub.	Rocky Mountain juniper, Russian mulberry, Russian-olive.	Eastern redcedar, green ash, Austrian pine, bur oak, honeylocust.	Siberian elm	---
Hedville.					
Mc: McCook	American plum, lilac.	Tatarian honeysuckle.	Eastern redcedar, ponderosa pine, hackberry, green ash, Russian-olive, Rocky Mountain juniper.	Honeylocust, Siberian elm.	Eastern cottonwood.
Nc: New Cambria	---	Silver buffaloberry, Siberian peashrub, Tatarian honeysuckle.	Eastern redcedar, green ash, Russian-olive, Russian mulberry, ponderosa pine.	Siberian elm, honeylocust, hackberry.	Eastern cottonwood.
Ns*: Nibson.					
Wakeen	Siberian peashrub, fragrant sumac, silver buffaloberry, Tatarian honeysuckle.	Eastern redcedar, Russian-olive, Rocky Mountain juniper, bur oak.	Honeylocust, Siberian elm, ponderosa pine, green ash.	---	---
Pt*. Pits					
Rb: Roxbury	American plum	Amur honeysuckle, lilac.	Russian mulberry, ponderosa pine, green ash, Russian-olive, Austrian pine, eastern redcedar.	Hackberry, honeylocust.	Eastern cottonwood.
Rc, Rf: Roxbury	American plum	Amur honeysuckle, lilac.	Eastern redcedar, Austrian pine, Russian-olive, ponderosa pine, green ash, Russian mulberry.	Hackberry, honeylocust.	Eastern cottonwood.
Sa: Saltine	Silver buffaloberry.	Russian-olive	Golden willow, Siberian elm.	---	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
To----------------- Tobin	American plum-----	Lilac, Amur honeysuckle.	Eastern redcedar, Russian-olive, Austrian pine, green ash, ponderosa pine, Russian mulberry.	Hackberry, honeylocust.	Eastern cottonwood.
Wg*:					
Wells-------------	Peking cotoneaster	Fragrant sumac, Amur honeysuckle, lilac.	Russian-olive, eastern redcedar, hackberry, bur oak, green ash.	Austrian pine, Scotch pine, honeylocust.	---
Edalgo-----------	Siberian peashrub, Amur honeysuckle, Peking cotoneaster.	Eastern redcedar, Rocky Mountain juniper, hackberry.	Austrian pine, honeylocust, Russian-olive, green ash, Russian mulberry.	Siberian elm------	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Am------ Armo	Slight------	Slight------	Moderate: slope.	Slight.
Ar------ Armo	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Cn------ Corinth	Slight------	Slight------	Moderate: slope, depth to rock.	Slight.
Co------ Corinth	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.
Cr------ Crete	Slight------	Slight------	Slight------	Slight.
De------ Detroit	Severe: flooding.	Slight------	Slight------	Slight.
Gc------ Geary	Slight------	Slight------	Moderate: slope.	Slight.
Gh*:				
Geary------	Slight------	Slight------	Severe: slope.	Slight.
Lancaster------	Slight------	Slight------	Severe: slope.	Slight.
Hb, Hc------ Harney	Slight------	Slight------	Moderate: slope.	Slight.
Hf*:				
Harney------	Slight------	Slight------	Moderate: slope.	Slight.
Wakeen------	Slight------	Slight------	Moderate: slope, depth to rock.	Slight.
Ho------ Hord	Severe: flooding.	Slight------	Slight------	Slight.
Lh*:				
Lancaster------	Slight------	Slight------	Severe: slope.	Slight.
Hedville------	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones.	Slight.
Mc------ McCook	Severe: flooding.	Slight------	Slight------	Slight.
Nc------ New Cambria	Severe: flooding.	Slight------	Moderate: flooding.	Slight.
Ns*:				
Nibson------	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: slope.
Wakeen------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Pt*. Pits				
Rb: Roxbury	Severe: flooding.	Slight	Slight	Slight.
Rc: Roxbury	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
Rf: Roxbury	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Sa: Saltine	Severe: flooding, excess sodium, excess salt.	Severe: excess sodium, excess salt.	Severe: flooding, excess sodium, excess salt.	Moderate: flooding.
To: Tobin	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Wg*:				
Wells	Slight	Slight	Moderate: slope.	Slight.
Edalgo	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones, depth to rock.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Am: Armo	Fair	Good	Good	---	---	Fair	Poor	Very poor.	Good	---	Very poor.	Fair.
Ar: Armo	Poor	Fair	Good	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
Cn, Co: Corinth	Fair	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Cr: Crete	Good	Good	Good	---	---	Fair	Poor	Poor	Good	Fair	Poor	Good.
De: Detroit	Good	Good	Good	---	---	Good	Poor	Poor	Good	---	Poor	Good.
Gc: Geary	Fair	Good	Good	---	---	Fair	Very poor.	Very poor.	Good	---	Very poor.	Good.
Gh*:												
Geary	Fair	Good	Good	---	---	Fair	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
Lancaster	Poor	Good	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Hb: Harney	Good	Good	Good	---	---	Good	Poor	Fair	Good	---	Poor	Good.
Hc: Harney	Fair	Good	Fair	---	---	Fair	Poor	Poor	Fair	---	Poor	Fair.
Hf*:												
Harney	Fair	Good	Fair	---	---	Fair	Poor	Poor	Fair	---	Poor	Fair.
Wakeen	Fair	Good	Fair	---	---	Poor	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Ho: Hord	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Lh*:												
Lancaster	Poor	Good	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Hedville	Very poor.	Poor	Poor	---	---	Poor	Very poor.	Very poor.	Poor	---	Very poor.	Poor.
Mc: McCook	Good	Good	Good	Good	Fair	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
Nc: New Cambria	Good	Good	Fair	Good	Good	Fair	Fair	Poor	Good	Good	Fair	Fair.
Ns*:												
Nibson	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Wakeen	Poor	Fair	Fair	---	---	Poor	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Pt*. Pits												

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hard-wood trees	Conif-erous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Open-land wild-life	Wood-land wild-life	Wetland wild-life	Range-land wild-life
Rb------------------ Roxbury	Good	Good	Good	Fair	Fair	Fair	Poor	Fair	Good	Fair	Poor	Fair.
Rc------------------ Roxbury	Fair	Fair	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Fair	Poor	Fair.
Rf------------------ Roxbury	Good	Good	Good	Fair	Fair	Fair	Poor	Fair	Good	Fair	Poor	Fair.
Sa------------------ Saltine	Poor	Good	Good	Poor	Poor	Poor	Good	Good	Poor	Poor	Good	Fair.
To------------------ Tobin	Good	Good	Good	Fair	Fair	Fair	Poor	Fair	Good	Fair	Poor	Fair.
Wg*:												
Wells---------------	Fair	Good	Good	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Edalgo--------------	Fair	Good	Good	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition. It does not eliminate the need for onsite investigation]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Am: Armo	Slight	Slight	Slight	Moderate: slope.	Severe: low strength.
Ar: Armo	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.
Cn: Corinth	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Co: Corinth	Moderate: depth to rock, slope, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: slope, shrink-swell.	Severe: low strength, shrink-swell.
Cr: Crete	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
De: Detroit	Moderate: too clayey.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.
Gc: Geary	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.
Gh*:					
Geary	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.
Lancaster	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, frost action.
Hb: Harney	Moderate: too clayey.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Severe: low strength.
Hc: Harney	Moderate: too clayey.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Severe: low strength.
Hf*:					
Harney	Moderate: too clayey.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Severe: low strength.
Wakeen	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Ho: Hord	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.
Lh*:					
Lancaster	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, frost action.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Lh*:					
Hedville	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.
Mc McCook	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, frost action.
Nc New Cambria	Moderate: too clayey, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, flooding, shrink-swell.
Ns*:					
Nibson	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: low strength, slope.
Wakeen	Moderate: depth to rock, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Severe: low strength.
Pt*. Pits					
Rb Roxbury	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.
Rc, Rf Roxbury	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.
Sa Saltine	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, flooding, frost action.
To Tobin	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.
Wg*:					
Wells	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Edalgo	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition. It does not eliminate the need for onsite investigation]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Am: Armo	Slight	Moderate: seepage, slope.	Slight	Slight	Fair: too clayey, thin layer.
Ar: Armo	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: too clayey, slope, thin layer.
Cn: Corinth	Severe: percs slowly, depth to rock.	Severe: depth to rock.	Severe: too clayey, depth to rock.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Co: Corinth	Severe: percs slowly, depth to rock.	Severe: slope, depth to rock.	Severe: too clayey, depth to rock.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Cr: Crete	Severe: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Poor: hard to pack.
De: Detroit	Severe: percs slowly.	Slight	Severe: too clayey.	Moderate: flooding.	Poor: too clayey, hard to pack.
Gc: Geary	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Gh*:					
Geary	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Lancaster	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Hb, Hc: Harney	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Hf*:					
Harney	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Wakeen	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Ho: Hord	Moderate: flooding.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
Lh*:					
Lancaster	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Hedville	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, small stones.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Mc------------------ McCook	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
Nc------------------ New Cambria	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
Ns*:					
Nibson--------------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
Wakeen--------------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Pt*. Pits					
Rb------------------ Roxbury	Moderate: flooding.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
Rc, Rf-------------- Roxbury	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
Sa------------------ Saltine	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness, excess sodium.	Severe: flooding, wetness.	Poor: excess salt, excess sodium.
To------------------ Tobin	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
Wg*:					
Wells---------------	Slight-----------	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
Edalgo--------------	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition. It does not eliminate the need for onsite investigation]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Am, Ar: Armo	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
Cn, Co: Corinth	Poor: low strength, area reclaim, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Cr: Crete	Poor: low strength, shrink-swell.	Improbable. excess fines.	Improbable: excess fines.	Poor: thin layer.
De: Detroit	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Gc: Geary	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Gh*:				
Geary	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Lancaster	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer.
Hb, Hc: Harney	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Hf*:				
Harney	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Wakeen	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
Ho: Hord	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Lh*:				
Lancaster	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer.
Hedville	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
Mc: McCook	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Nc: New Cambria	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Ns*:				
Nibson	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ns*:				
Wakeen	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, slope.
Pt*. Pits				
Rb, Rc, Rf Roxbury	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Sa Saltine	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, excess sodium.
To Tobin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Wg*:				
Wells	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Edalgo	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition. It does not eliminate the need for onsite investigation]

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
Am: Armo	Moderate: seepage, slope.	Moderate: thin layer, piping.	Deep to water	Slope	Favorable	Favorable.
Ar: Armo	Severe: slope.	Moderate: thin layer, piping.	Deep to water	Slope	Slope	Slope.
Cn: Corinth	Moderate: slope, depth to rock.	Moderate: thin layer, hard to pack.	Deep to water	Slope, percs slowly, depth to rock.	Depth to rock, erodes easily.	Depth to rock, erodes easily.
Co: Corinth	Severe: slope.	Moderate: thin layer, hard to pack.	Deep to water	Slope, percs slowly, depth to rock.	Slope, depth to rock, erodes easily.	Slope, depth to rock, erodes easily.
Cr: Crete	Moderate: seepage.	Moderate: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily	Erodes easily, percs slowly.
De: Detroit	Slight	Moderate: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Gc: Geary	Moderate: seepage, slope.	Slight	Deep to water	Slope	Erodes easily	Erodes easily.
Gh*:						
Geary	Moderate: seepage, slope.	Slight	Deep to water	Slope	Erodes easily	Erodes easily.
Lancaster	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Depth to rock	Depth to rock.
Hb: Harney	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
Hc: Harney	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
Hf*:						
Harney	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
Wakeen	Moderate: seepage, depth to rock, slope.	Moderate: thin layer, piping.	Deep to water	Depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
Ho: Hord	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable	Favorable	Favorable.
Lh*:						
Lancaster	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Depth to rock	Depth to rock.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Lh*:						
Hedville	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Droughty, depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
Mc McCook	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
Nc New Cambria	Slight	Severe: hard to pack.	Deep to water	Percs slowly, flooding.	Percs slowly	Percs slowly.
Ns*:						
Nibson	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
Wakeen	Severe: slope.	Moderate: thin layer, piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Pt*. Pits						
Rb Roxbury	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
Rc, Rf Roxbury	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Flooding	Erodes easily	Erodes easily.
Sa Saltine	Moderate: seepage.	Severe: excess sodium, excess salt.	Percs slowly, flooding, frost action.	Wetness, percs slowly, flooding.	Wetness	Excess salt, excess sodium, percs slowly.
To Tobin	Moderate: seepage.	Moderate: piping.	Deep to water	Flooding	Favorable	Favorable.
Wg*:						
Wells	Moderate: seepage, slope.	Moderate: thin layer, piping.	Deep to water	Slope	Favorable	Favorable.
Edalgo	Moderate: depth to rock, slope.	Moderate: thin layer, hard to pack.	Deep to water	Percs slowly, depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Am, Ar----------- Armo	0-14	Loam-------------	CL	A-6, A-4	0	95-100	90-100	90-100	70-95	25-40	7-18
	14-40	Loam, silty clay loam, clay loam.	CL	A-6, A-4, A-7	0	95-100	90-100	90-100	70-90	25-45	7-22
	40-60	Silt loam, gravelly clay loam, gravelly loam.	CL, SC, GC	A-6, A-4	0	60-85	50-85	50-60	40-55	25-35	8-18
Cn, Co----------- Corinth	0-6	Silty clay loam	CL, CH	A-7, A-6	0	100	100	95-100	70-90	38-60	18-35
	6-30	Silty clay, silty clay loam.	CH, CL	A-7	0	100	100	95-100	75-95	40-60	20-40
	30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Cr--------------- Crete	0-6	Silt loam--------	CL, ML	A-4, A-6	0	100	100	100	95-100	30-40	5-15
	6-40	Silty clay, silty clay loam.	CH	A-7	0	100	100	100	95-100	50-65	25-40
	40-60	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	100	95-100	30-55	10-35
De--------------- Detroit	0-12	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	20-30
	12-31	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	90-100	50-60	25-35
	31-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	95-100	85-100	25-45	10-25
Gc--------------- Geary	0-9	Silt loam--------	ML, CL	A-4, A-6	0	100	100	96-100	80-98	25-40	2-15
	9-42	Silty clay loam, clay loam.	CL	A-7, A-6	0	100	100	96-100	85-98	35-50	15-25
	42-60	Silty clay loam, clay loam, silt loam.	CL	A-6, A-7	0	100	100	96-100	85-98	30-45	11-22
Gh*: Geary-----------	0-8	Silt loam--------	ML, CL	A-4, A-6	0	100	100	96-100	80-98	25-40	2-15
	8-34	Silty clay loam, clay loam.	CL	A-7, A-6	0	100	100	96-100	85-98	35-50	15-25
	34-60	Silty clay loam, clay loam, loam.	CL	A-6, A-7	0	100	100	96-100	85-98	30-45	11-22
Lancaster--------	0-10	Loam-------------	CL-ML, CL	A-4, A-6	0-5	95-100	90-100	85-100	60-90	20-35	5-15
	10-31	Sandy clay loam, clay loam, loam.	CL, SC	A-4, A-6, A-7-6	0	100	95-100	80-95	40-65	25-45	8-25
	31	Weathered bedrock	---	---	---	---	---	---	---	---	---
Hb--------------- Harney	0-8	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-20
	8-53	Silty clay, silty clay loam.	CL, CH	A-7-6	0	100	100	95-100	85-100	40-60	15-35
	53-60	Silty clay loam, silt loam.	CL	A-6, A-7-6	0	100	100	95-100	85-100	30-45	10-20
Hc--------------- Harney	0-6	Silty clay loam	CL	A-6, A-7-6	0	100	100	95-100	85-100	30-45	15-22
	6-50	Silty clay, silty clay loam.	CL, CH	A-7-6	0	100	100	95-100	85-100	40-60	15-35
	50-60	Silty clay loam, silt loam.	CL	A-6, A-7-6	0	100	100	95-100	85-100	30-45	10-20
Hf*: Harney----------	0-6	Silty clay loam	CL	A-6, A-7-6	0	100	100	95-100	85-100	30-45	15-22
	6-50	Silty clay, silty clay loam.	CL, CH	A-7-6	0	100	100	95-100	85-100	40-60	15-35
	50-60	Silty clay loam, silt loam.	CL	A-6, A-7-6	0	100	100	95-100	85-100	30-45	10-20

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Hf*:											
Wakeen----------	0-11	Silt loam--------	CL	A-4, A-6	0	100	100	95-100	75-95	25-40	7-20
	11-35	Silty clay loam, silt loam.	CL, ML	A-6, A-7-6	0	95-100	85-100	75-100	60-95	30-50	10-25
	35	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Ho--------------- Hord	0-12	Silt loam--------	CL, ML, CL-ML	A-4, A-6	0	100	100	95-100	85-100	20-35	3-18
	12-40	Silt loam, silty clay loam, loam.	CL	A-6, A-4	0	100	100	98-100	85-100	25-40	8-23
	40-60	Silt loam, very fine sandy loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	100	100	100	85-100	25-40	6-21
Lh*:											
Lancaster--------	0-10	Loam-------------	CL-ML, CL	A-4, A-6	0-5	95-100	90-100	85-100	60-90	20-35	5-15
	10-31	Sandy clay loam, clay loam, loam.	CL, SC	A-4, A-6, A-7-6	0	100	95-100	80-95	40-65	25-45	8-25
	31-36	Fine sandy loam, loam, sandy clay loam.	CL-ML, SC, SM-SC, CL	A-4, A-6	0-10	95-100	90-100	80-100	36-80	20-35	5-15
	36	Weathered bedrock	---	---	---	---	---	---	---	---	---
Hedville---------	0-17	Stony loam-------	SM, ML, SC, CL	A-4, A-6	15-25	70-100	70-100	50-85	35-70	<35	NP-13
	17	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Mc--------------- McCook	0-14	Silt loam--------	ML, CL, CL-ML	A-4	0	100	100	95-100	60-100	20-35	2-10
	14-60	Very fine sandy loam, silt loam, loam.	ML, CL, CL-ML	A-4	0	100	100	95-100	55-100	<20	NP-10
Nc--------------- New Cambria	0-6	Silty clay loam	CL, CH	A-7-6	0	100	100	95-100	85-100	40-55	20-30
	6-48	Silty clay, silty clay loam, clay.	CH	A-7-6	0	100	100	95-100	85-100	50-75	30-45
	48-60	Silty clay, silty clay loam.	CH, CL	A-7-6	0	100	100	95-100	85-100	40-60	20-40
Ns*:											
Nibson----------	0-7	Silt loam--------	CL	A-4, A-6	0-15	85-100	80-95	65-95	60-90	25-40	8-20
	7-19	Silty clay loam, silt loam.	CL	A-6, A-7	0-15	85-95	80-95	60-90	55-90	30-45	10-25
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Wakeen----------	0-11	Silt loam--------	CL	A-4, A-6	0	100	100	95-100	75-95	25-40	7-20
	11-35	Silty clay loam, silt loam.	CL, ML	A-6, A-7-6	0	95-100	85-100	75-100	60-95	30-50	10-25
	35	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Pt*. Pits											
Rb, Rc, Rf-------- Roxbury	0-14	Silt loam--------	CL	A-4, A-6	0	100	100	95-100	65-100	25-40	7-20
	14-60	Silt loam, silty clay loam.	CL	A-4, A-6, A-7-6	0	100	100	95-100	80-100	30-50	8-25
Sa--------------- Saltine	0-12	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	70-95	35-50	15-30
	12-22	Silt loam, silty clay loam, loam.	CL	A-4, A-6, A-7	0	100	100	85-100	60-95	25-50	7-25
	22-60	Silty clay loam, silt loam, silty clay.	CL, CH	A-4, A-6, A-7	0	100	100	95-100	70-95	25-55	7-35
To--------------- Tobin	0-8	Silt loam--------	CL	A-4, A-6	0	100	100	95-100	90-100	25-35	8-15
	8-60	Silt loam, silty clay loam, loam.	CL	A-4, A-6, A-7	0	100	100	95-100	90-100	25-45	8-20

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Wg*:											
Wells-----------	0-6	Loam-------------	CL	A-6, A-7	0	100	100	90-100	70-80	35-50	15-30
	6-52	Clay loam, sandy clay loam.	SC, CL	A-4, A-6, A-7	0	100	100	80-100	40-85	30-50	8-25
	52-60	Clay loam, sandy clay loam, sandy loam.	SC, CL, ML, SM	A-4, A-6	0	100	100	80-100	35-85	20-40	NP-15
Edalgo----------	0-6	Silt loam--------	CL, CL-ML	A-4, A-6	0	95-100	85-100	75-100	50-90	20-40	5-15
	6-36	Silty clay, clay, silty clay loam.	CH, CL	A-7-6	0	95-100	85-100	75-100	70-95	45-70	20-40
	36	Weathered bedrock	---	---	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH	mmhos/cm					Pct
Am, Ar-----------	0-14	18-27	1.25-1.40	0.6-2.0	0.21-0.24	6.6-8.4	<2	Low--------	0.28	5	4L	1-3
Armo	14-40	18-35	1.30-1.40	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low--------	0.28			
	40-60	18-30	1.30-1.50	0.6-2.0	0.15-0.21	7.9-8.4	<2	Low--------	0.28			
Cn, Co-----------	0-6	27-39	1.35-1.50	0.2-0.6	0.19-0.23	7.4-8.4	<2	Moderate	0.37	4	4L	.5-1
Corinth	6-30	35-45	1.45-1.50	0.06-0.6	0.11-0.18	7.4-8.4	<2	High-------	0.37			
	30	---	---	---	---	---	---	----------	----			
Cr---------------	0-6	20-27	1.20-1.40	0.6-2.0	0.22-0.24	5.6-6.0	<2	Moderate	0.37	4	6	2-4
Crete	6-40	42-52	1.10-1.30	0.06-0.6	0.12-0.20	6.1-7.3	<2	High-------	0.37			
	40-60	25-40	1.20-1.40	0.2-2.0	0.18-0.22	7.4-8.4	<2	High-------	0.37			
De---------------	0-12	28-35	1.25-1.40	0.2-0.6	0.21-0.23	6.1-7.3	<2	Moderate	0.37	5	7	2-4
Detroit	12-31	35-45	1.35-1.50	0.06-0.2	0.12-0.18	6.6-7.8	<2	High-------	0.37			
	31-60	18-35	1.30-1.50	0.2-0.6	0.18-0.22	6.6-8.4	<2	Moderate	0.37			
Gc---------------	0-9	15-27	1.30-1.40	0.6-2.0	0.22-0.24	5.6-6.5	<2	Low--------	0.32	5	6	1-4
Geary	9-42	27-35	1.35-1.50	0.6-2.0	0.17-0.20	5.6-7.8	<2	Moderate	0.43			
	42-60	20-32	1.30-1.40	0.6-2.0	0.15-0.19	6.1-8.4	<2	Moderate	0.43			
Gh*:												
Geary-----------	0-8	15-27	1.30-1.40	0.6-2.0	0.22-0.24	5.6-6.5	<2	Low--------	0.32	5	6	1-4
	8-34	27-35	1.35-1.50	0.6-2.0	0.17-0.20	5.6-7.8	<2	Moderate	0.43			
	34-60	20-32	1.30-1.40	0.6-2.0	0.15-0.19	6.1-8.4	<2	Moderate	0.43			
Lancaster--------	0-10	12-26	1.35-1.45	0.6-2.0	0.17-0.22	5.6-6.5	<2	Low--------	0.28	4	6	1-4
	10-31	18-35	1.35-1.50	0.6-2.0	0.15-0.19	5.6-7.3	<2	Moderate	0.28			
	31	---	---	---	---	---	---	----------	----			
Hb---------------	0-8	22-27	1.30-1.40	0.6-2.0	0.22-0.24	5.6-7.8	<2	Low--------	0.32	5	6	2-4
Harney	8-53	35-42	1.35-1.50	0.2-0.6	0.12-0.19	6.1-8.4	<2	Moderate	0.43			
	53-60	24-35	1.20-1.35	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low--------	0.43			
Hc---------------	0-6	28-35	1.30-1.40	0.6-2.0	0.21-0.23	5.6-7.8	<2	Moderate	0.32	5	7	2-4
Harney	6-50	35-42	1.35-1.50	0.2-0.6	0.12-0.19	6.1-8.4	<2	Moderate	0.43			
	50-60	24-35	1.20-1.35	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low--------	0.43			
Hf*:												
Harney----------	0-6	28-35	1.30-1.40	0.6-2.0	0.21-0.23	5.6-7.8	<2	Moderate	0.32	5	7	2-4
	6-50	35-42	1.35-1.50	0.2-0.6	0.12-0.19	6.1-8.4	<2	Moderate	0.43			
	50-60	24-35	1.20-1.35	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low--------	0.43			
Wakeen----------	0-11	18-27	1.30-1.45	0.6-2.0	0.22-0.24	7.4-8.4	<2	Low--------	0.32	4	4L	1-3
	11-35	18-35	1.35-1.50	0.6-2.0	0.18-0.22	7.4-9.0	<2	Moderate	0.43			
	35	---	---	---	---	---	---	----------	----			
Ho---------------	0-12	17-27	1.30-1.40	0.6-2.0	0.20-0.24	5.6-7.3	<2	Low--------	0.32	5	6	2-4
Hord	12-40	20-35	1.35-1.45	0.6-2.0	0.17-0.22	6.1-7.8	<2	Low--------	0.32			
	40-60	18-30	1.30-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low--------	0.43			
Lh*:												
Lancaster--------	0-10	12-26	1.35-1.45	0.6-2.0	0.17-0.22	5.6-6.5	<2	Low--------	0.28	4	6	1-4
	10-31	18-35	1.35-1.50	0.6-2.0	0.15-0.19	5.6-7.3	<2	Moderate	0.28			
	31-36	12-30	1.40-1.55	0.6-2.0	0.15-0.19	6.1-7.3	<2	Low--------	0.28			
	36	---	---	---	---	---	---	----------	----			
Hedville---------	0-17	8-22	1.35-1.50	0.6-2.0	0.09-0.14	5.6-7.3	<2	Low--------	0.24	2	8	1-4
	17	---	---	---	---	---	---	----------	----			
Mc---------------	0-14	15-20	1.20-1.40	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low--------	0.32	5	4L	2-4
McCook	14-60	10-18	1.30-1.45	0.6-2.0	0.17-0.20	7.4-8.4	<2	Low--------	0.43			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH	mmhos/cm					Pct
Nc---------------- New Cambria	0-6	30-40	1.30-1.40	0.06-0.2	0.21-0.23	6.6-8.4	<2	High------	0.37	5	7	2-4
	6-48	38-60	1.35-1.45	0.06-0.2	0.13-0.18	7.9-8.4	<2	High------	0.28			
	48-60	30-50	1.35-1.45	0.06-0.6	0.12-0.16	7.9-8.4	<2	High------	0.28			
Ns*:												
Nibson-----------	0-7	15-27	1.25-1.35	0.6-2.0	0.20-0.24	7.4-9.0	<2	Low--------	0.32	2	4L	1-2
	7-19	18-35	1.30-1.40	0.6-2.0	0.18-0.22	7.9-9.0	<2	Moderate	0.32			
	19	---	---	---	---	---	---	----------	----			
Wakeen-----------	0-11	18-27	1.30-1.45	0.6-2.0	0.22-0.24	7.4-8.4	<2	Low--------	0.32	4	4L	1-3
	11-35	18-35	1.35-1.50	0.6-2.0	0.18-0.22	7.4-9.0	<2	Moderate	0.43			
	35	---	---	---	---	---	---	----------	----			
Pt*. Pits												
Rb---------------- Roxbury	0-14	18-27	1.30-1.45	0.6-2.0	0.22-0.24	7.4-8.4	<2	Low--------	0.32	5	4L	2-4
	14-60	18-35	1.35-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.43			
Rc, Rf------------ Roxbury	0-14	18-27	1.30-1.45	0.6-2.0	0.22-0.24	6.6-8.4	<2	Low--------	0.32	5	4L	2-4
	14-60	18-35	1.35-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.43			
Sa---------------- Saltine	0-12	27-35	1.20-1.30	0.2-0.6	0.17-0.23	7.4-9.0	>4	High------	0.32	5	4L	.5-2
	12-22	20-40	1.20-1.30	0.6-2.0	0.17-0.22	>8.4	>4	Moderate	0.32			
	22-60	20-45	1.30-1.40	0.06-0.6	0.10-0.22	>7.3	<2	High------	0.32			
To---------------- Tobin	0-8	18-27	1.30-1.40	0.6-2.0	0.20-0.24	5.6-7.8	<2	Moderate	0.32	5	6	1-4
	8-60	18-35	1.35-1.50	0.6-2.0	0.17-0.20	7.4-8.4	<2	Moderate	0.32			
Wg*:												
Wells------------	0-6	27-32	1.40-1.60	0.2-0.6	0.17-0.20	5.6-6.5	<2	Moderate	0.28	5	6	1-3
	6-52	25-35	1.35-1.50	0.6-2.0	0.15-0.19	5.6-7.3	<2	Moderate	0.28			
	52-60	10-30	1.35-1.60	0.6-2.0	0.12-0.18	6.1-7.8	<2	Low--------	0.28			
Edalgo-----------	0-6	15-27	1.30-1.40	0.6-2.0	0.18-0.24	5.6-7.3	<2	Low--------	0.37	3	6	2-4
	6-36	35-65	1.40-1.60	<0.06	0.10-0.18	6.6-8.4	<2	High------	0.37			
	36	---	---	---	---	---	---	----------	----			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," and "apparent" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Am, Ar Armo	B	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
Cn, Co Corinth	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Low.
Cr Crete	C	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
De Detroit	C	Rare	---	---	>6.0	---	---	>60	---	Low	High	Low.
Gc Geary	B	None	---	---	>6.0	---	---	>60	---	High	Low	Low.
Gh*:												
Geary	B	None	---	---	>6.0	---	---	>60	---	High	Low	Low.
Lancaster	B	None	---	---	>6.0	---	---	20-40	Soft	Moderate	Low	Moderate.
Hb, Hc Harney	B	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Hf*:												
Harney	B	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Wakeen	B	None	---	---	>6.0	---	---	20-40	Soft	Low	Moderate	Low.
Ho Hord	B	Rare	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
Lh*:												
Lancaster	B	None	---	---	>6.0	---	---	20-40	Soft	Moderate	Low	Moderate.
Hedville	D	None	---	---	>6.0	---	---	4-20	Hard	Moderate	Low	Moderate.
Mc McCook	B	Rare	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
Nc New Cambria	C	Occasional	Very brief	Mar-Sep	>6.0	---	---	>60	---	Low	High	Low.
Ns*:												
Nibson	D	None	---	---	>6.0	---	---	10-20	Soft	Moderate	Low	Low.
Wakeen	B	None	---	---	>6.0	---	---	20-40	Soft	Low	Moderate	Low.
Pt*. Pits												

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Rb: Roxbury	B	Rare	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
Rc: Roxbury	B	Frequent	Very brief	Apr-Sep	>6.0	---	---	>60	---	Moderate	Low	Low.
Rf: Roxbury	B	Occasional	Very brief	Apr-Sep	>6.0	---	---	>60	---	Moderate	Low	Low.
Sa: Saltine	C	Frequent	Brief	Apr-Jul	2.0-3.0	Apparent	Nov-Jul	>60	---	High	High	High.
To: Tobin	B	Occasional	Very brief	Mar-Dec	>6.0	---	---	>60	---	Moderate	Low	Low.
Wg*:												
Wells	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Moderate.
Edalgo	C	None	---	---	>6.0	---	---	20-40	Soft	Moderate	Moderate	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Armo	Fine-loamy, mixed, mesic Entic Haplustolls
Corinth	Fine, mixed, mesic Typic Ustochrepts
Crete	Fine, montmorillonitic, mesic Pachic Argiustolls
Detroit	Fine, montmorillonitic, mesic Pachic Argiustolls
Edalgo	Fine, mixed, mesic Udic Argiustolls
Geary	Fine-silty, mixed, mesic Udic Argiustolls
Harney	Fine, montmorillonitic, mesic Typic Argiustolls
Hedville	Loamy, mixed, mesic Lithic Haplustolls
Hord	Fine-silty, mixed, mesic Cumulic Haplustolls
Lancaster	Fine-loamy, mixed, mesic Udic Argiustolls
McCook	Coarse-silty, mixed, mesic Fluventic Haplustolls
New Cambria	Fine, montmorillonitic, mesic Cumulic Haplustolls
Nibson	Loamy, carbonatic, mesic, shallow Entic Haplustolls
Roxbury	Fine-silty, mixed, mesic Cumulic Haplustolls
*Saltine	Fine-silty, mixed, mesic Typic Halaquepts
Tobin	Fine-silty, mixed, mesic Cumulic Haplustolls
Wakeen	Fine-silty, carbonatic, mesic Entic Haplustolls
Wells	Fine-loamy, mixed, mesic Udic Argiustolls

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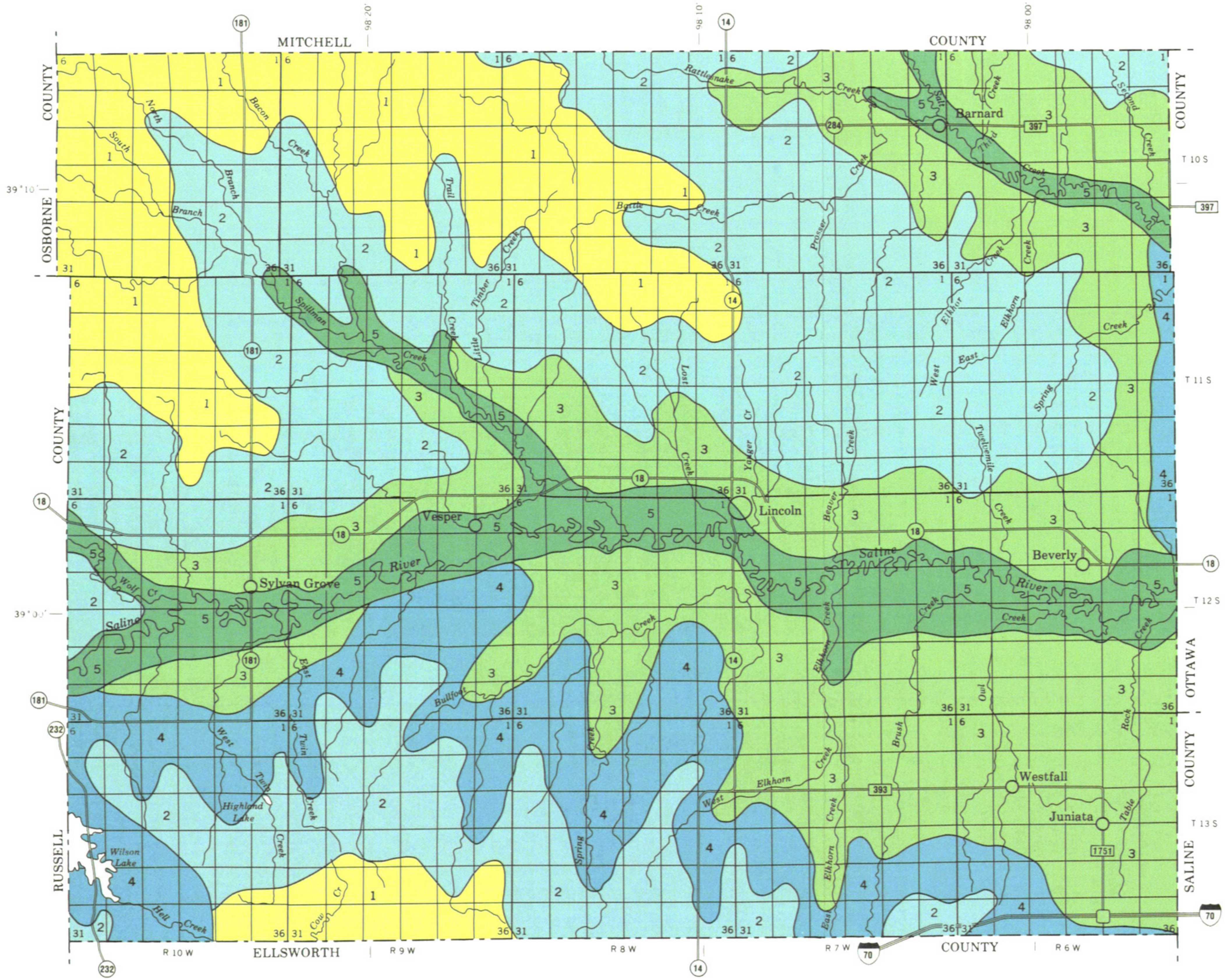


LEGEND

1 — HARNEY association: Deep, gently sloping and moderately sloping, well drained soils that have a silty or clayey subsoil; on uplands

2 — HARNEY-NIBSON-ARMO association: Deep and shallow, gently sloping to moderately steep, well drained and somewhat excessively drained soils that have a silty, clayey, or loamy subsoil; on uplands

3 — GEARY-HARNEY-LANCASTER association: Deep and moderately deep, gently sloping to strongly sloping, well drained soils that have a silty, clayey, or loamy subsoil; on uplands

4 — LANCASTER-HEDVILLE association: Moderately deep and shallow, moderately sloping to moderately steep, well drained and somewhat excessively drained soils that have a loamy subsoil; on uplands

5 — ROXBURY-NEW CAMBRIA association: Deep, nearly level, well drained and moderately well drained soils that have a silty or clayey subsoil; on stream terraces and flood plains

Compiled 1983

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
KANSAS AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP
LINCOLN COUNTY
KANSAS

Scale 1:190,080

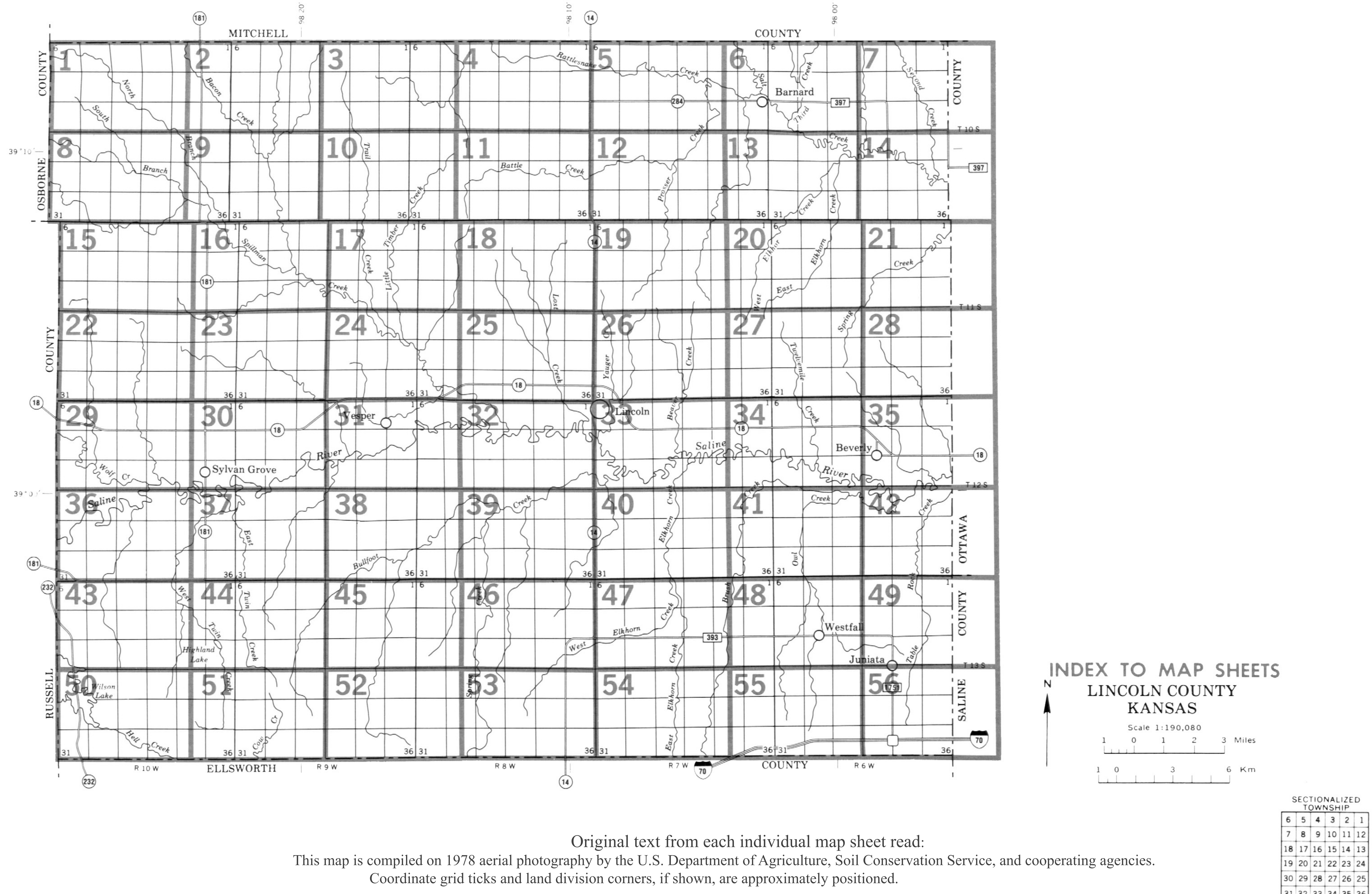
1 0 1 2 3 Miles

1 0 3 6 Km

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



Original text from each individual map sheet read:
This map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service, and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL LEGEND

SYMBOL	NAME
Am	Armo loam, 3 to 7 percent slopes
Ar	Armo loam, 7 to 15 percent slopes
Cn	Corinth silty clay loam, 3 to 7 percent slopes
Co	Corinth silty clay loam, 7 to 15 percent slopes
Cr	Crete silt loam, 0 to 2 percent slopes
De	Detroit silty clay loam
Gc	Geary silt loam, 2 to 7 percent slopes
Gh	Geary-Lancaster complex, 5 to 10 percent slopes
Hb	Harney silt loam, 1 to 3 percent slopes
Hc	Harney silty clay loam, 3 to 7 percent slopes
Hf	Harney-Wakeen complex, 2 to 7 percent slopes
Ho	Hord silt loam
Lh	Lancaster-Hedville complex, 3 to 20 percent slopes
Mc	McCook silt loam
Nc	New Cambria silty clay loam, occasionally flooded
Ns	Nibson-Wakeen silt loams, 5 to 25 percent slopes
Pt	Pits, quarries
Rb	Roxbury silt loam
Rc	Roxbury silt loam, channeled
Rf	Roxbury silt loam, occasionally flooded
Sa	Saltine silty clay loam, frequently flooded
To	Tobin silt loam, occasionally flooded
Wg	Wells-Edalgo complex, 3 to 7 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEM & DESIGNATIONS

- Interstate
- Federal
- State
- County, farm or ranch

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label)
- Located object (label)
- Tank (label)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial
- Intermittent

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

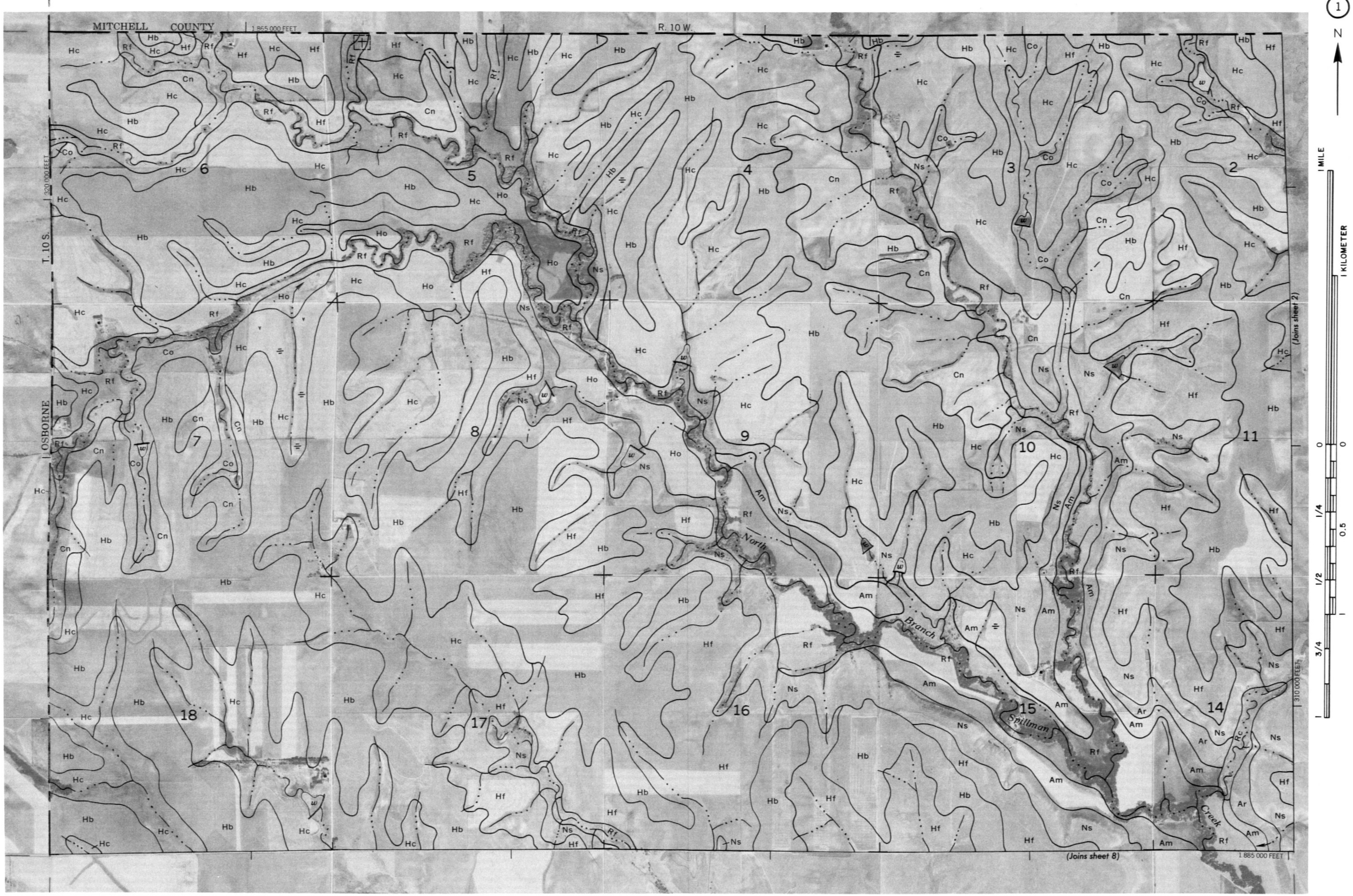
GULLY

DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown)

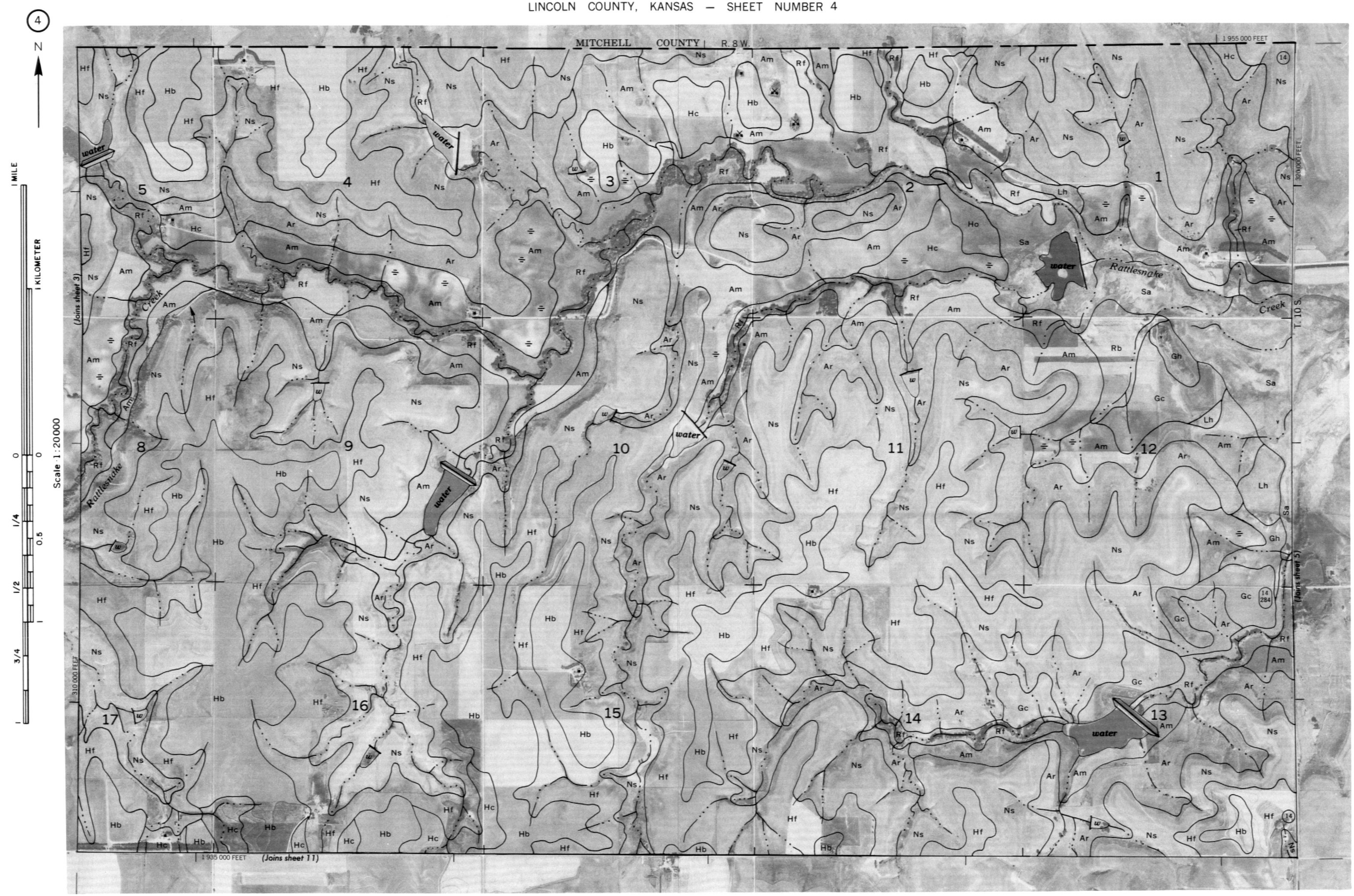
MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Limy spot
- Borrow area


1
N
MITCHELL COUNTY
1 865 000 FEET
R. 10 W.
T. 10 S.
OSBORNE
320 000 FEET
North
Branch
Spillman
Creek
(Joins sheet 2)
(Joins sheet 8)
1 885 000 FEET
310 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5


2
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
MITCHELL COUNTY
R. 10 W.
R. 9 W.
T. 10 S.
1 905 000 FEET
320 000 FEET
310 000 FEET
1 890 000 FEET
(Joins sheet 1)
(Joins sheet 3)
(Joins sheet 9)
Bacon Creek
RAILROAD
181
water


3
N
MITCHELL COUNTY
R. 9 W.
R. 8 W.
T. 10 S.
1 910 000 FEET
320 000 FEET
310 000 FEET
1 930 000 FEET
(Joins sheet 2)
(Joins sheet 4)
(Joins sheet 10)
Rattlesnake
Creek
Bethany Church
water
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
Hb
Hc
Hf
Co
Cn
Rf
Rc
Ns
Am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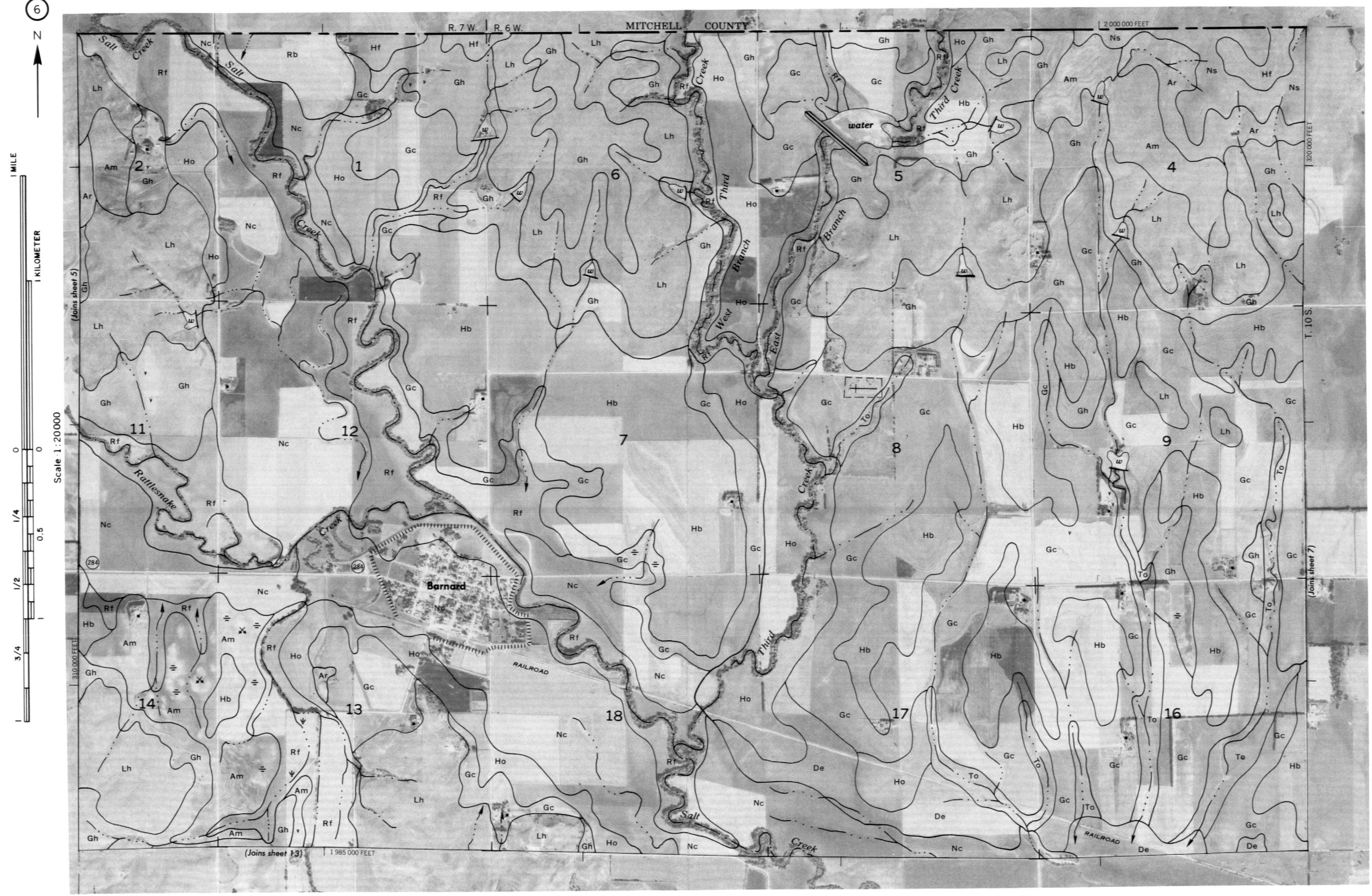
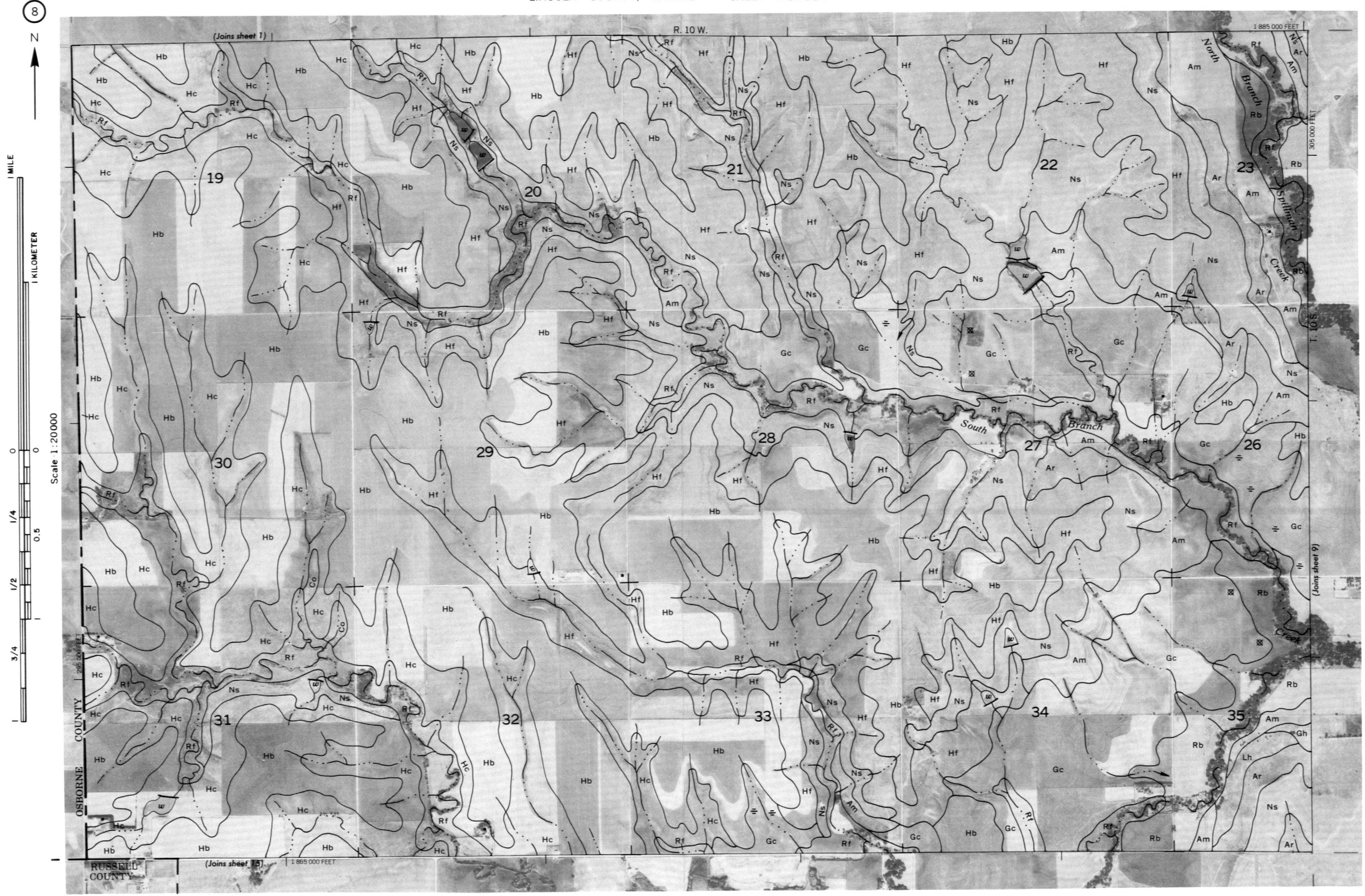
MITCHELL COUNTY
R. 8 W.
1 955 000 FEET
320 000 FEET
T. 10 S.
(Joins sheet 3)
(Joins sheet 5)
1 935 000 FEET
(Joins sheet 11)
310 000 FEET
Rattlesnake Creek
Scale 1:20000
1 MILE
1 KILOMETER


5
N
MITCHELL COUNTY
R. 7 W.
1 960 000 FEET
320 000 FEET
T. 10 S.
water
Rattlesnake
Creek
Prosser
(Joins sheet 4)
(Joins sheet 6)
(Joins sheet 12)
310 000 FEET
1 980 000 FEET
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0.5
Scale 1:20000


6
N
1 MILE
1 KILOMETER
Scale 1:20000
R. 7 W.
R. 6 W.
MITCHELL COUNTY
2 000 000 FEET
320 000 FEET
T. 10 S.
(Joins sheet 5)
(Joins sheet 7)
(Joins sheet 13)
1 985 000 FEET
310 000 FEET
Salt Creek
Third Creek
West Branch
East Branch
Rattlesnake Creek
water
Barnard
284
RAILROAD


MITCHELL COUNTY
OTTAWA COUNTY
R. 6 W.
T. 10 S.
2 005 000 FEET
320 000 FEET
310 000 FEET
2 025 000 FEET
(Joins sheet 6)
(Joins sheet 14)
Second Creek
Creek
7
N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
Scale 1:20000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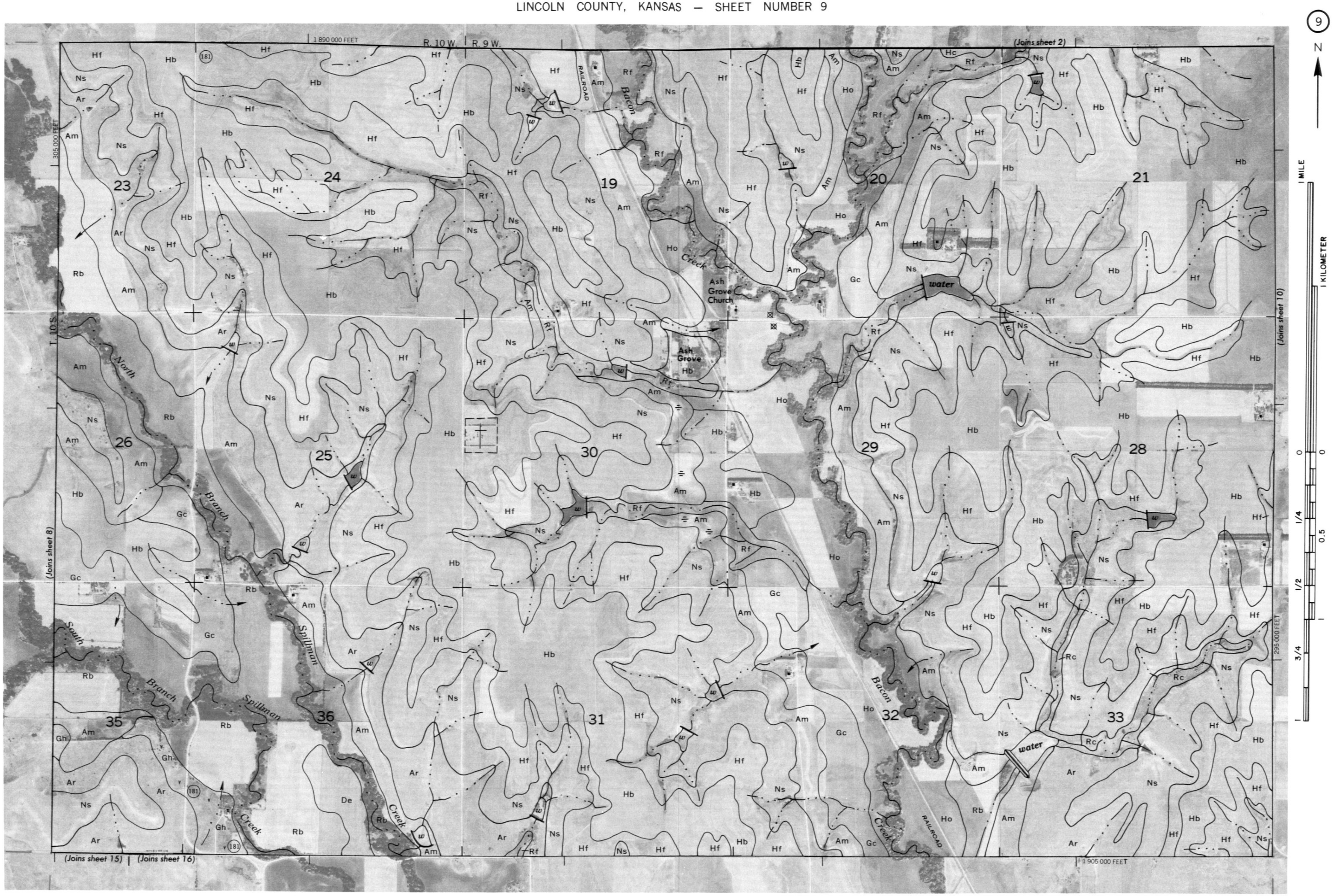
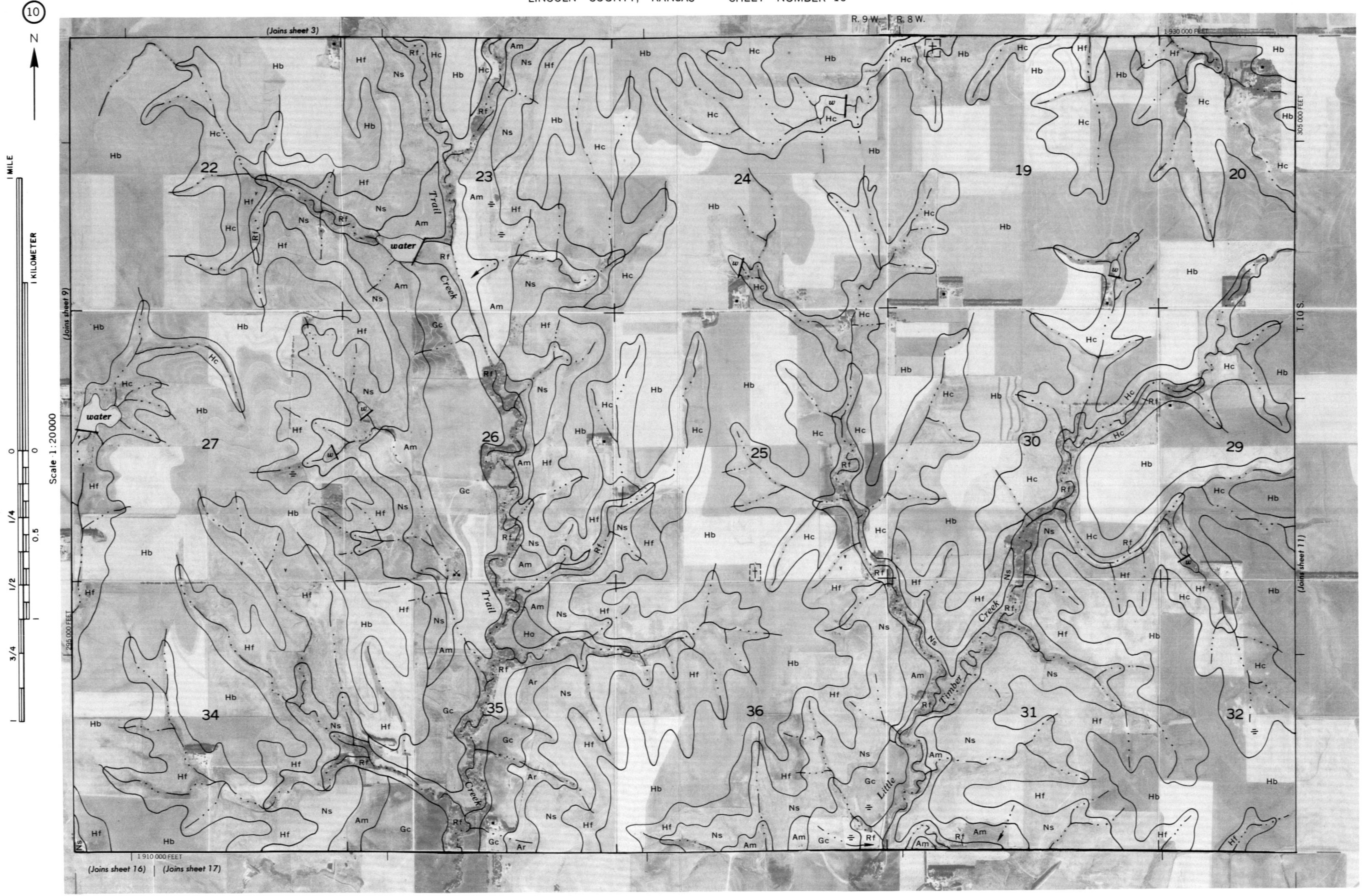
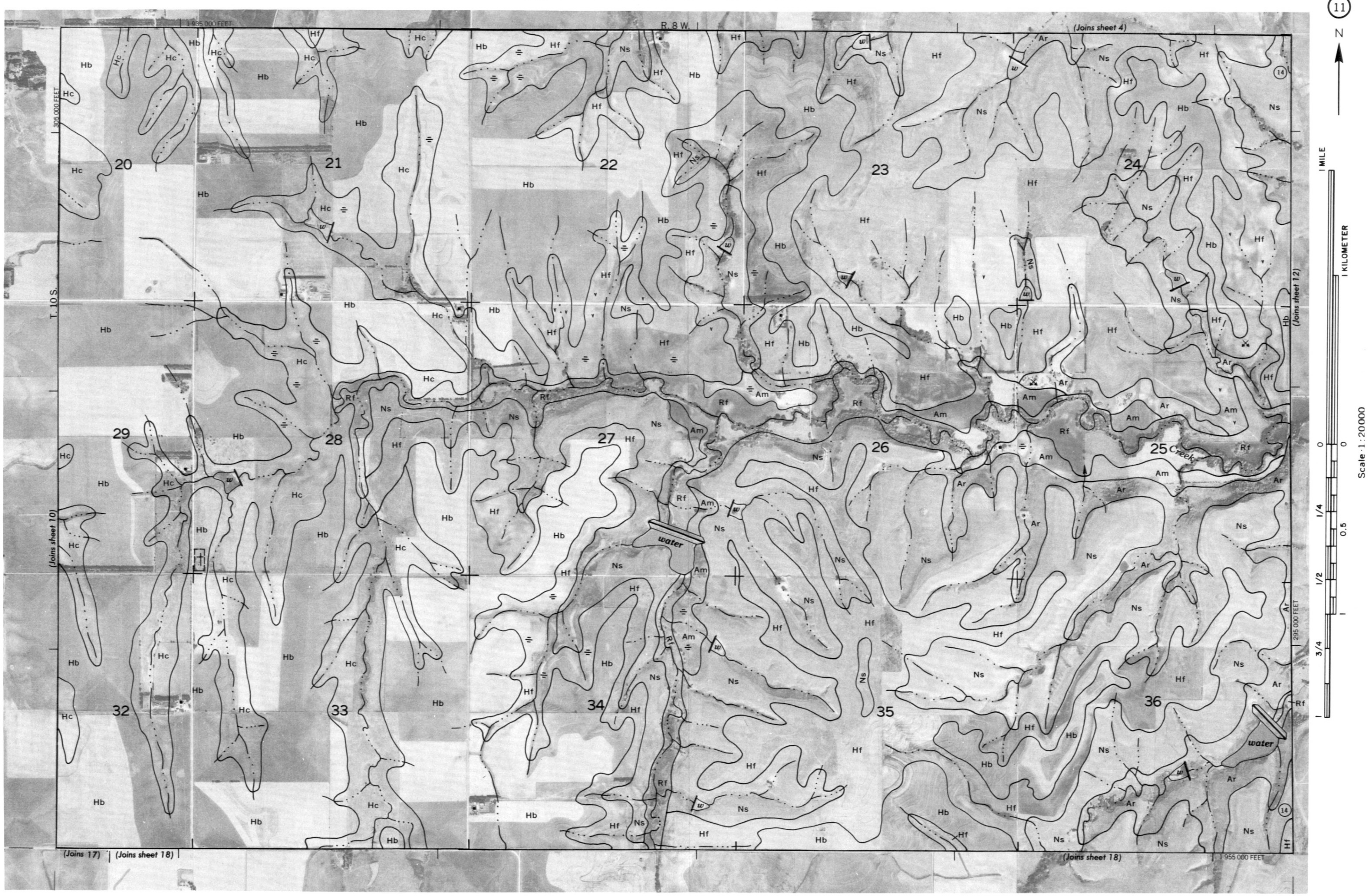
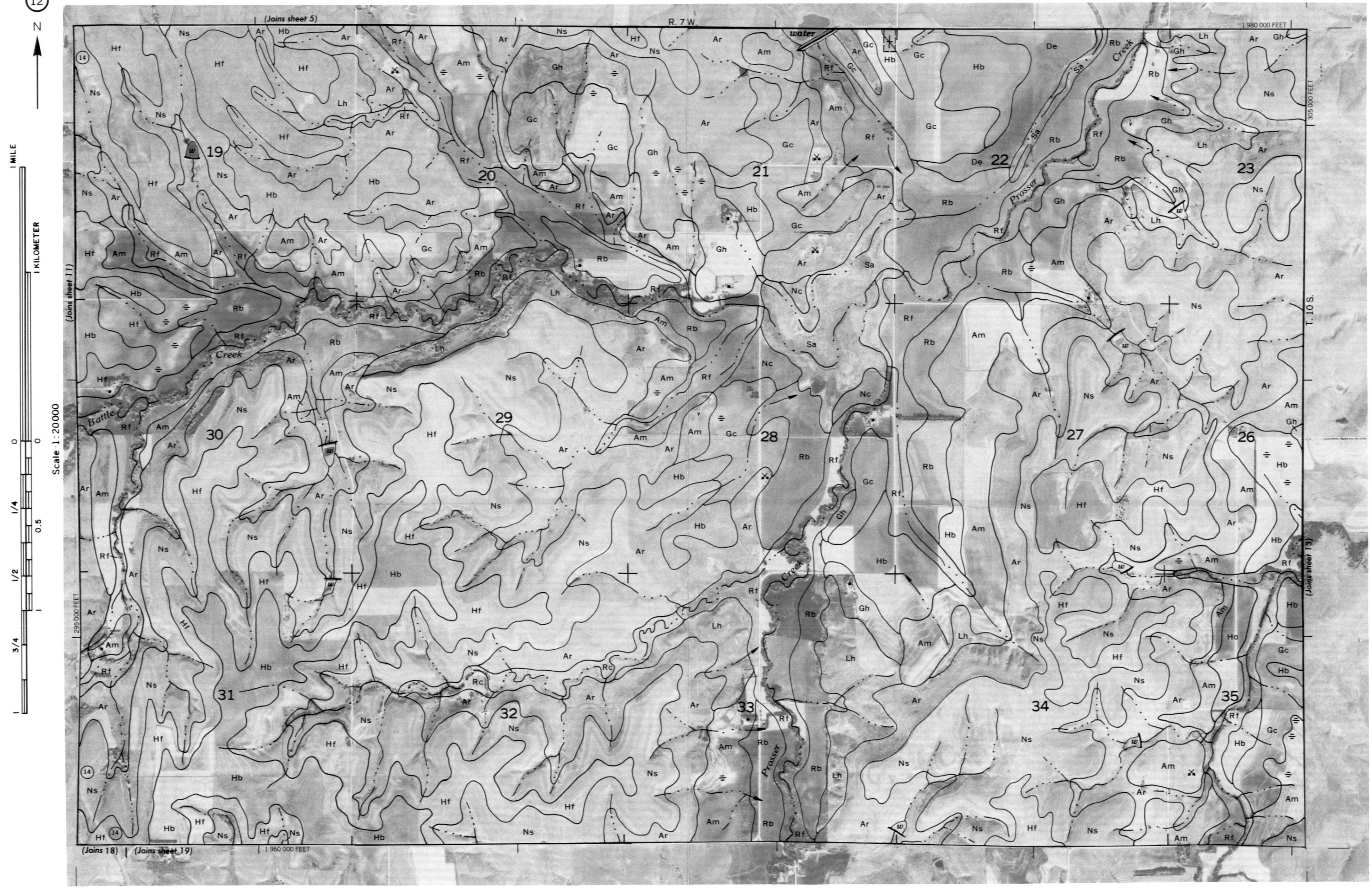
N
(Joins sheet 1)
R. 10 W.
1 885 000 FEET
305 000 FEET
T. 10 S.
(Joins sheet 9)
(Joins sheet 15)
1 865 000 FEET
295 000 FEET
OSBORNE COUNTY
RUSSELL COUNTY
North Branch
Spillman Creek
South Branch
Creek
1 MILE
1 KILOMETER
Scale 1:20 000
0
1/4
1/2
3/4
0.5
1
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35

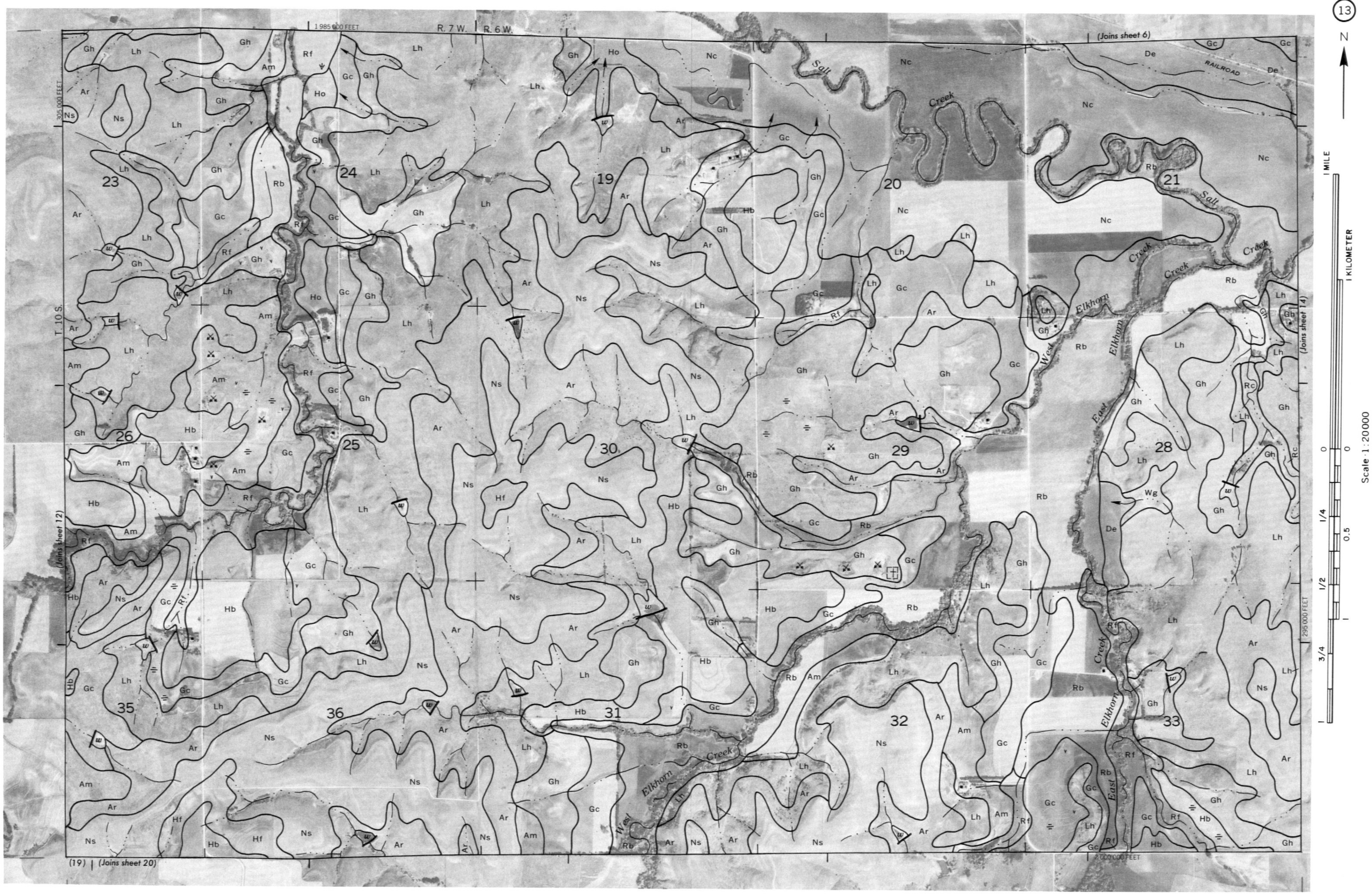

9
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
1 890 000 FEET
R. 10 W.
R. 9 W.
(Joins sheet 2)
(Joins sheet 10)
(Joins sheet 8)
(Joins sheet 15)
(Joins sheet 16)
305 000 FEET
299 000 FEET
1 905 000 FEET
T. 10 S.
RAILROAD
Bacon
Creek
Ash Grove Church
Ash Grove
North
Branch
South
Branch
Spillman
Creek
water
181
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36

LINCOLN COUNTY, KANSAS — SHEET NUMBER 10

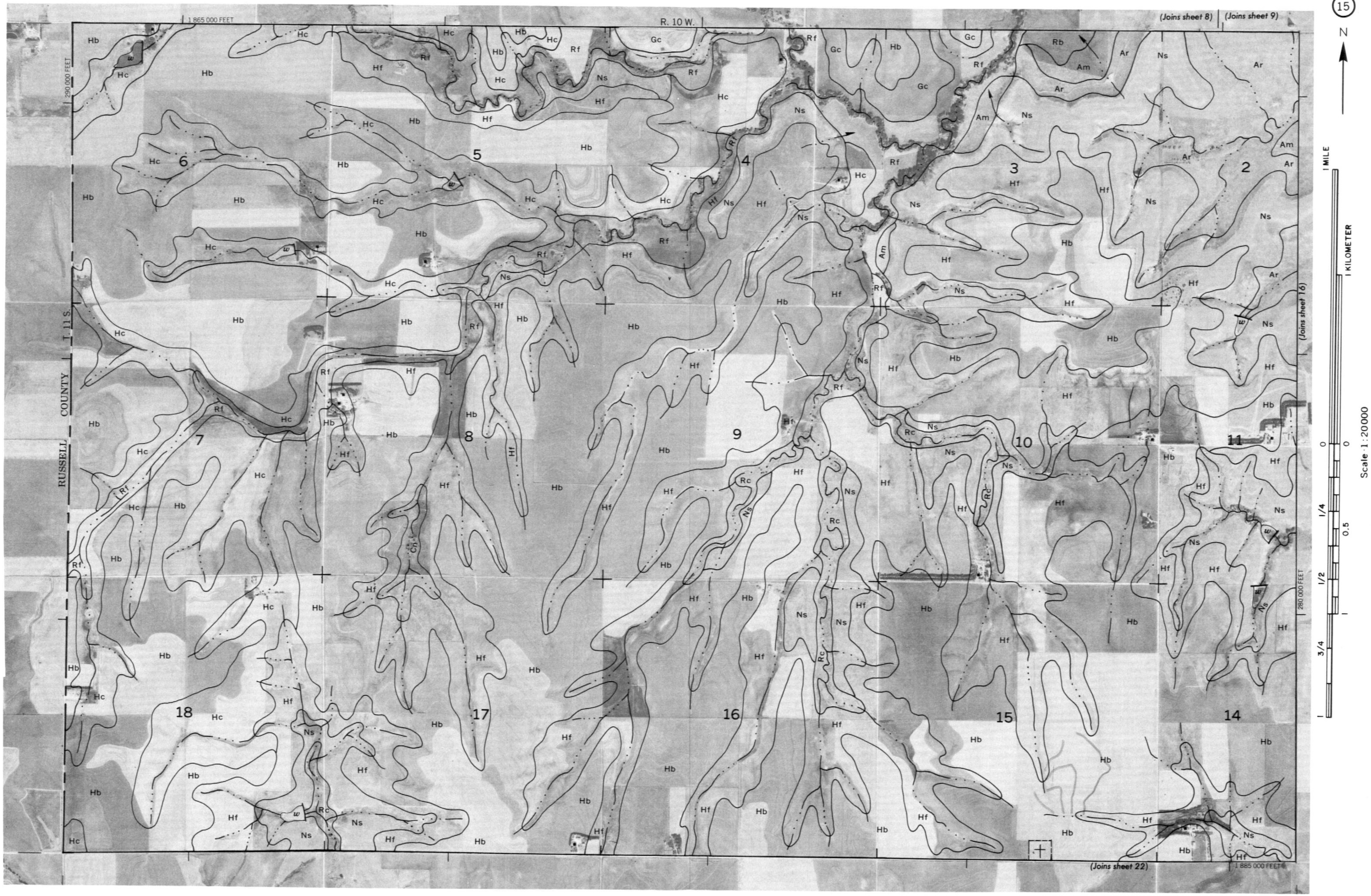


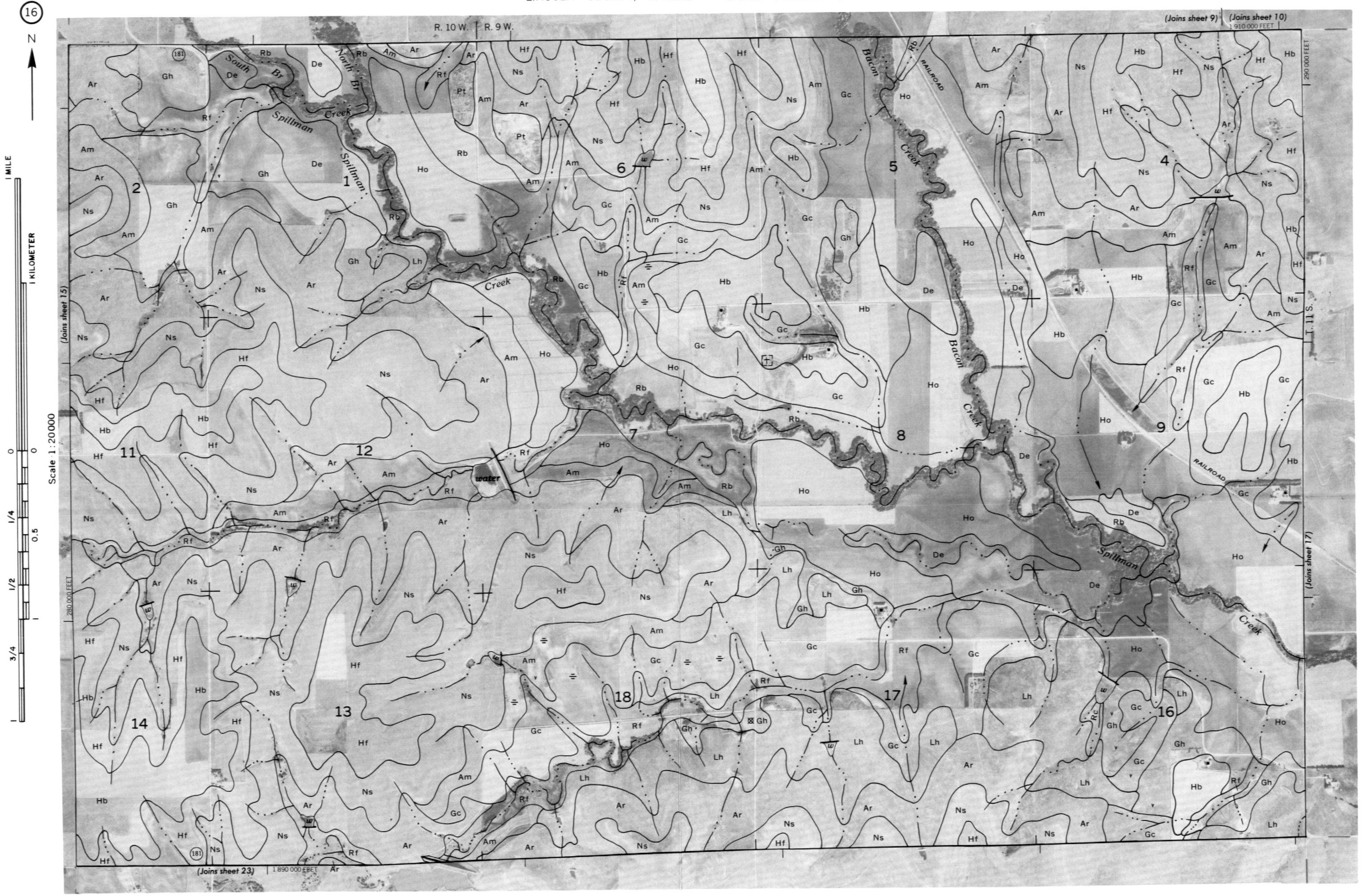

11
N
(Joins sheet 4)
(Joins sheet 12)
(Joins sheet 10)
(Joins 17)
(Joins sheet 18)
(Joins sheet 18)
R. 8 W.
T. 10 S.
1 935 000 FEET
1 955 000 FEET
305 000 FEET
295 000 FEET
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
Creek
water
water
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5

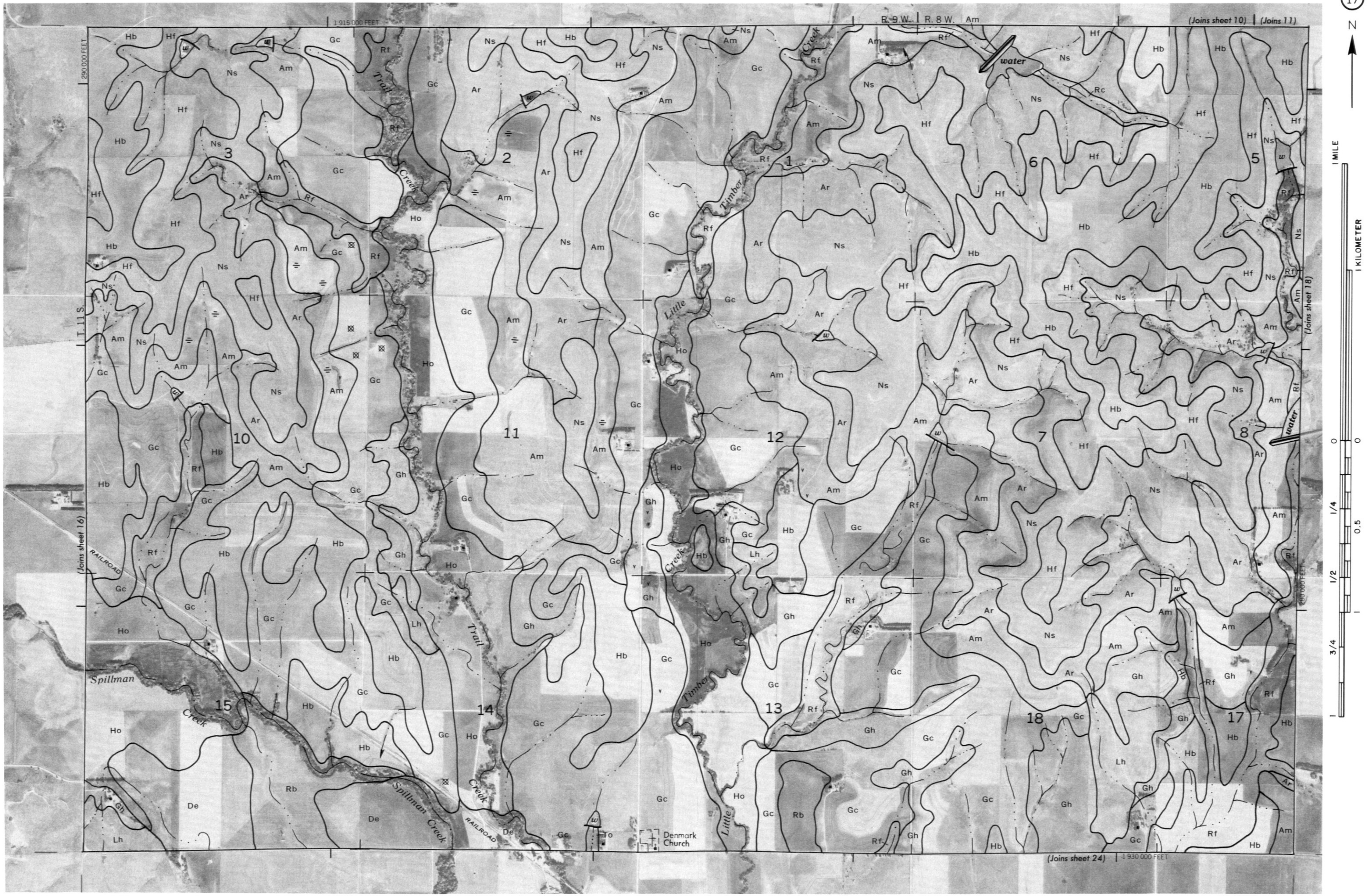

N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 5)
R. 7 W.
1 980 000 FEET
305 000 FEET
T. 10 S.
(Joins sheet 11)
(Joins sheet 13)
295 000 FEET
(Joins 18)
(Joins sheet 19)
1 960 000 FEET
water
Battle Creek
Prosser Creek
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35


13
N
1 985 000 FEET
R. 7 W.
R. 6 W.
(Joins sheet 6)
305 000 FEET
T. 10 S.
(Joins sheet 12)
(Joins sheet 14)
295 000 FEET
(19)
(Joins sheet 20)
2 000 000 FEET
RAILROAD
Salt Creek
Salt Creek
Elkhorn Creek
West Elkhorn Creek
East Elkhorn Creek
West Elkhorn Creek
East Elkhorn Creek
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0
0.5
1
Scale 1:20000

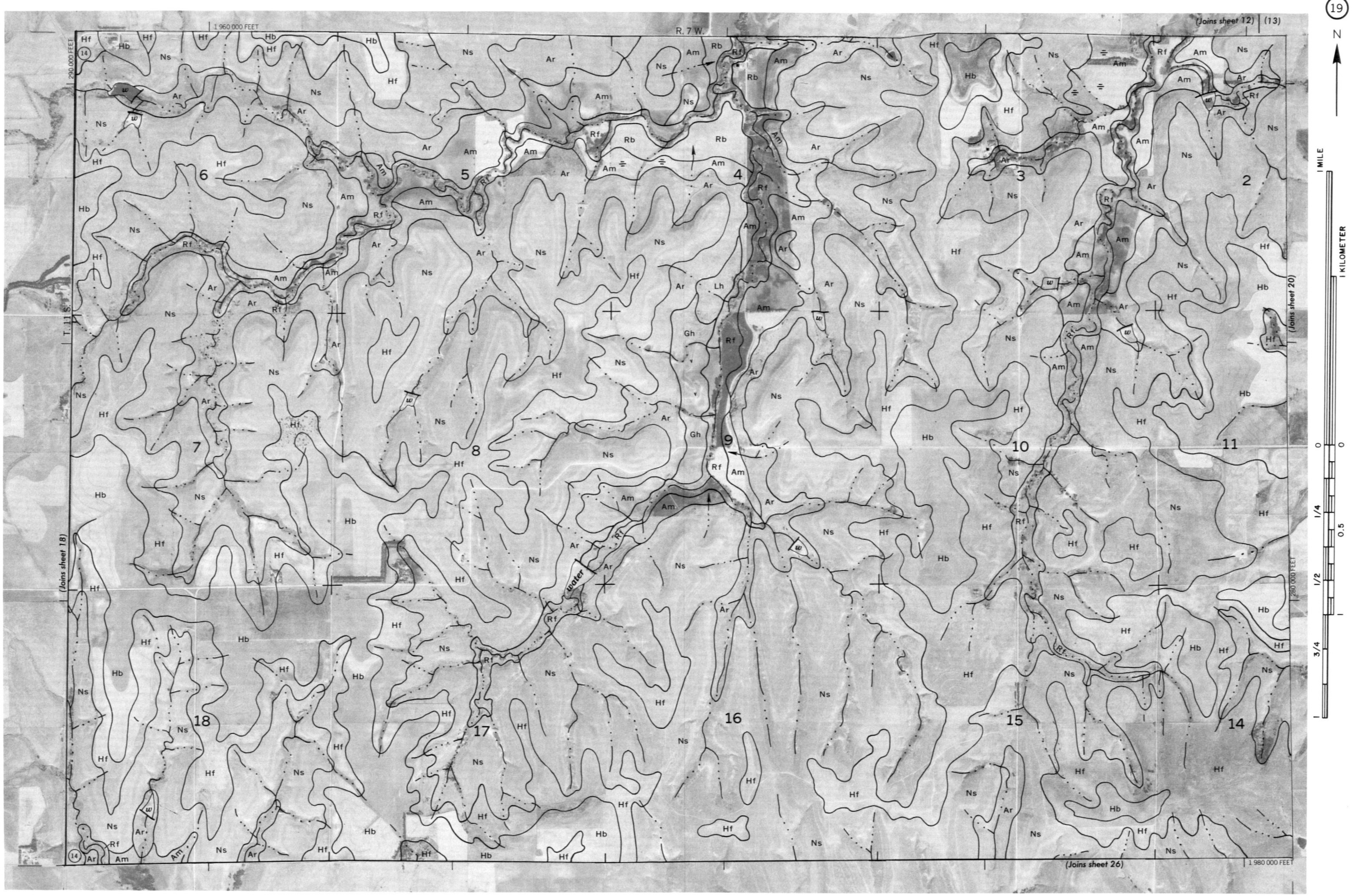

14
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 7)
R. 6 W.
2 025 000 FEET
305 000 FEET
RAILROAD
Salt Creek
Second Creek
(Joins sheet 13)
T. 10 S.
OTTAWA COUNTY
22
23
24
25
26
27
34
35
36
295 000 FEET
2 005 000 FEET
(20)
(Joins sheet 21)
OTTAWA COUNTY


15
N
(Joins sheet 8)
(Joins sheet 9)
(Joins sheet 16)
(Joins sheet 22)
1 865 000 FEET
1 885 000 FEET
290 000 FEET
280 000 FEET
R. 10 W.
T. 11 S.
RUSSELL COUNTY
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5

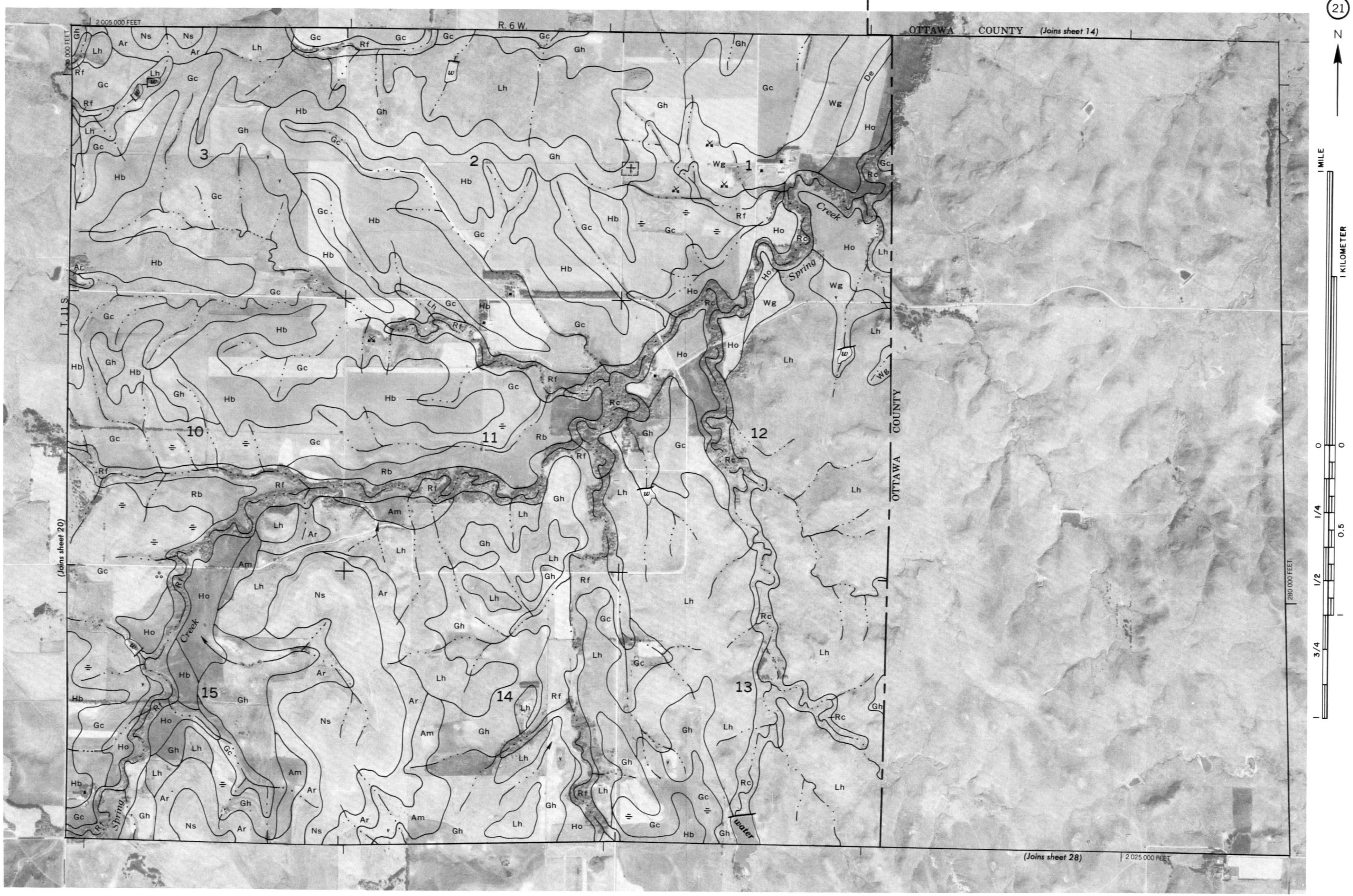

16
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
R. 10 W.
R. 9 W.
(Joins sheet 9)
(Joins sheet 10)
1 910 000 FEET
290 000 FEET
(Joins sheet 15)
(Joins sheet 17)
(Joins sheet 23)
1 890 000 FEET
280 000 FEET
T. 11 S.
181
South Br
North Br
Spillman Creek
Spillman
Creek
Bacon Creek
Bacon
RAILROAD
water

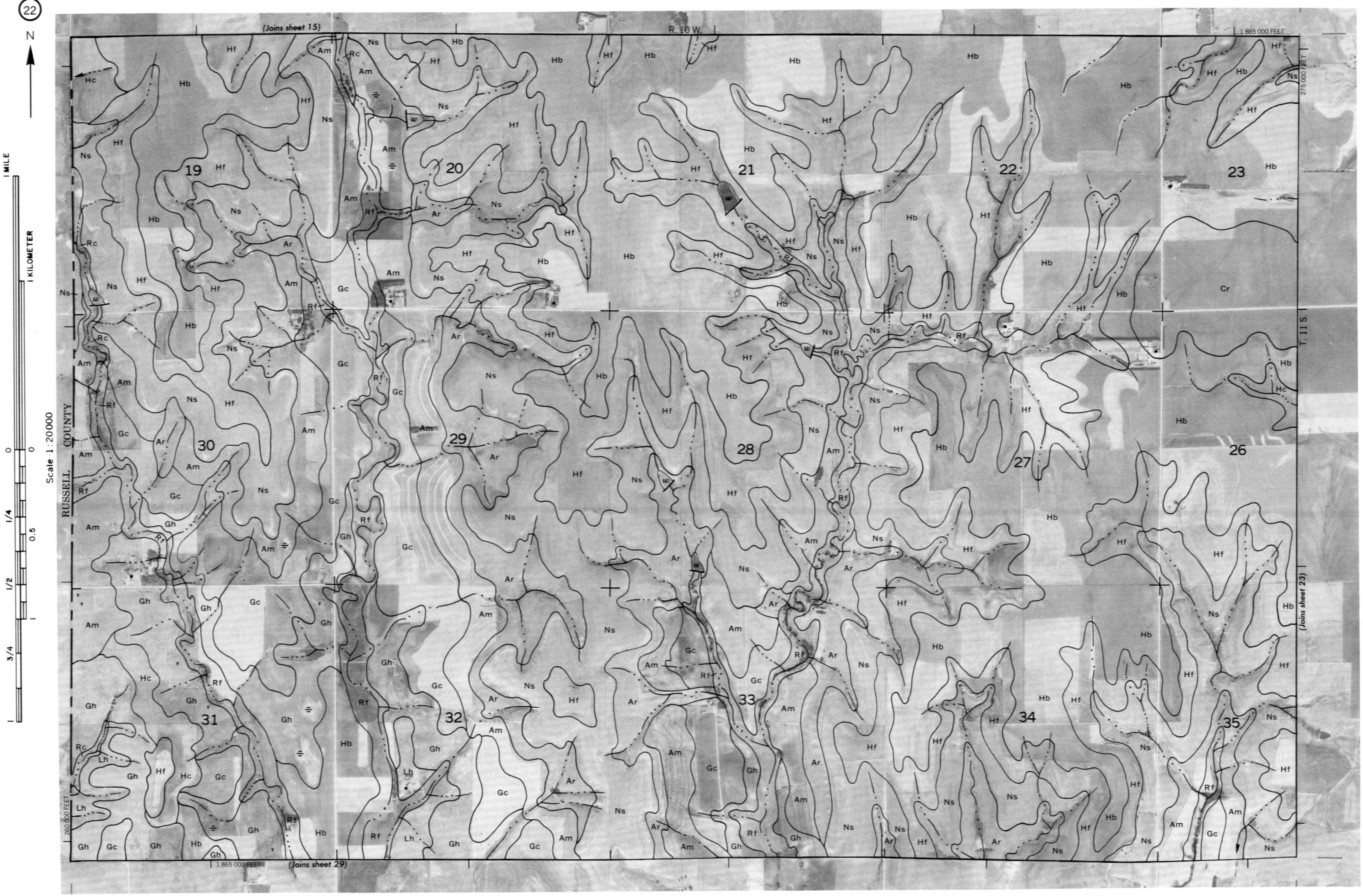

17
N
(Joins sheet 10)
(Joins 11)
(Joins sheet 18)
(Joins sheet 16)
(Joins sheet 24)
R. 9 W.
R. 8 W.
T. 11 S.
1 915 000 FEET
1 930 000 FEET
290 000 FEET
Trail Creek
Little Timber Creek
Spillman Creek
RAILROAD
Denmark Church
water
1 MILE
1 KILOMETER
Scale 1:20000

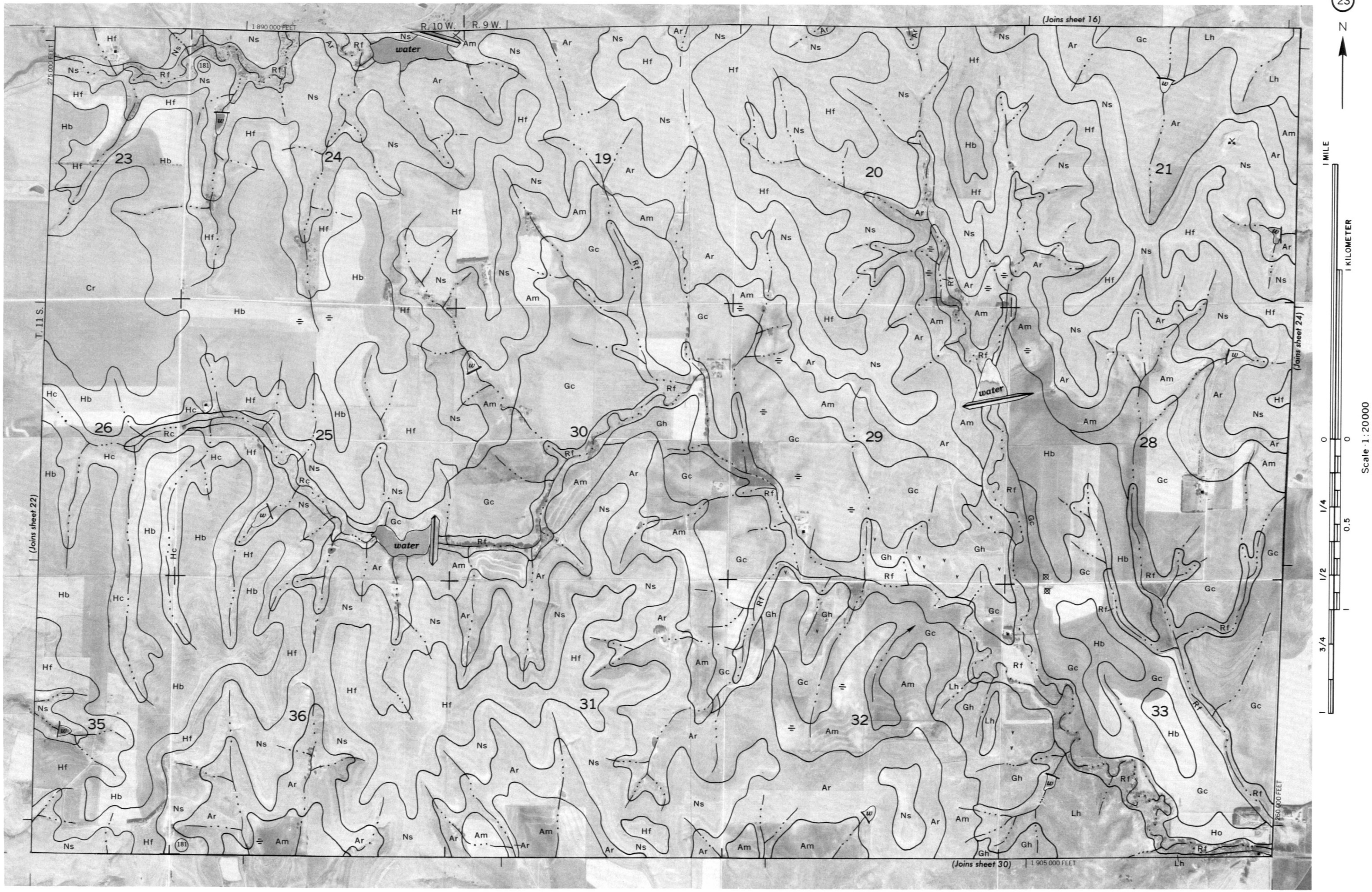

18
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 11)
(Joins 12)
R. 8 W.
1 955 000 FEET
290 000 FEET
T. 11 S.
(Joins sheet 17)
(Joins sheet 19)
(Joins sheet 25)
1 935 000 FEET
250 000 FEET
Lost Creek
water
14


19
N
(Joins sheet 12)
(13)
R. 7 W.
1 960 000 FEET
290 000 FEET
T. 11 S.
(Joins sheet 20)
(Joins sheet 18)
(Joins sheet 26)
280 000 FEET
1 980 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
water

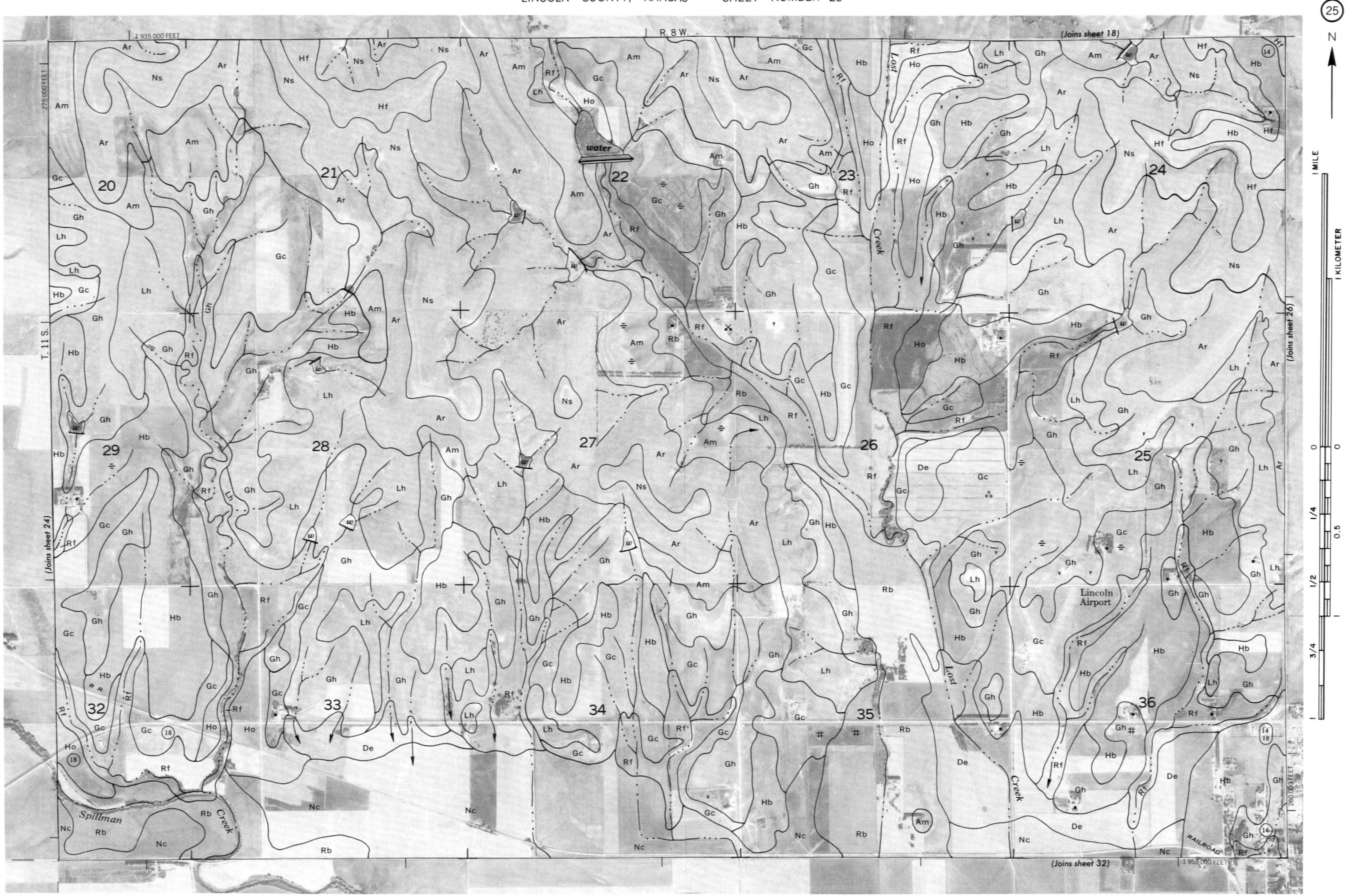

20
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
R. 7 W.
R. 6 W.
2 000 000 FEET
(Joins sheet 13)
(14)
290 000 FEET
T. 11 S.
(Joins sheet 21)
(Joins sheet 19)
280 000 FEET
(Joins sheet 27)
1 985 000 FEET
West Elkhorn
Creek
East Elkhorn Creek
water

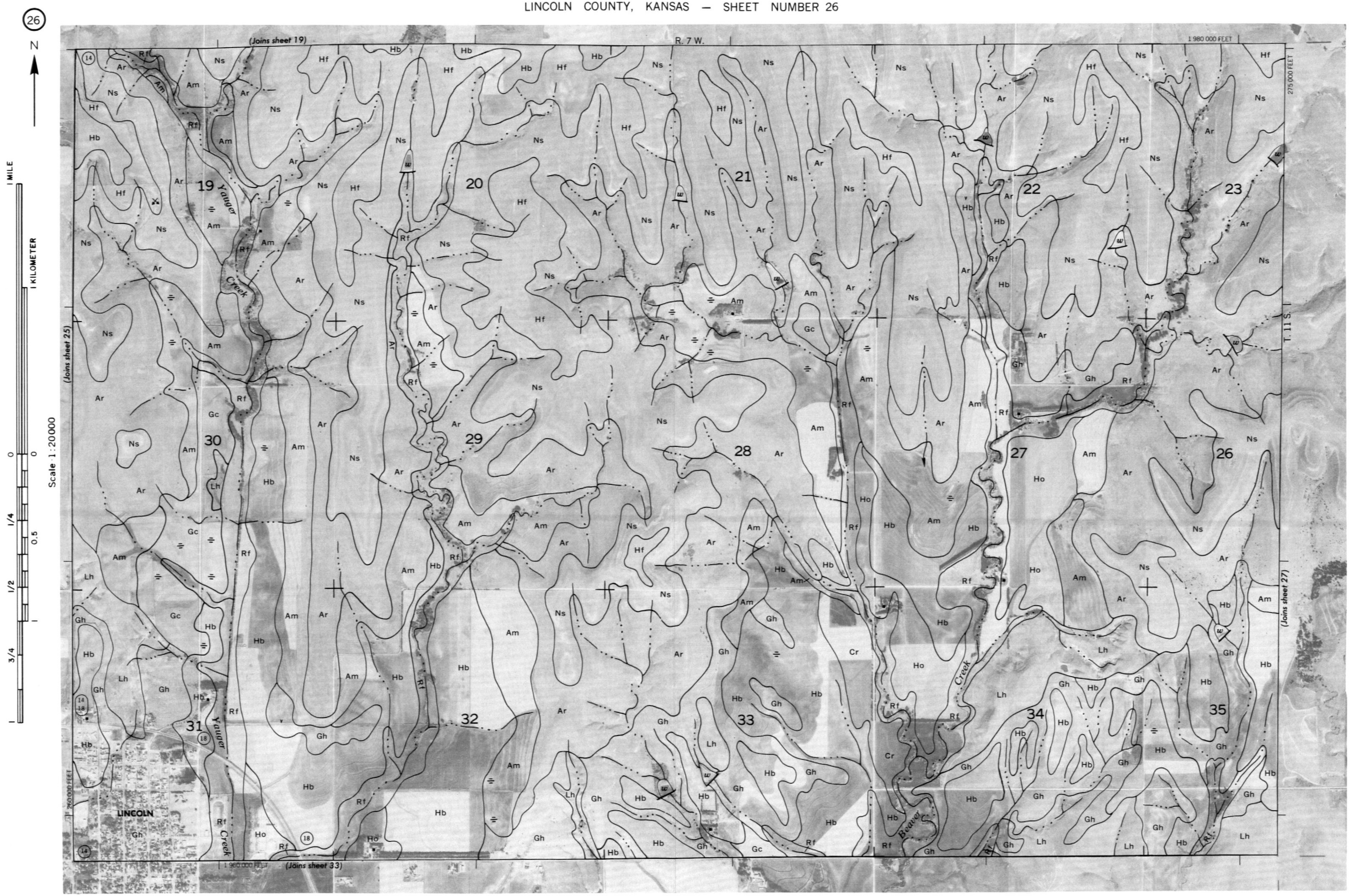

21
N
R. 6 W.
T. 11 S.
2 005 000 FEET
280 000 FEET
OTTAWA COUNTY (Joins sheet 14)
OTTAWA COUNTY
(Joins sheet 20)
(Joins sheet 28)
2 025 000 FEET
280 000 FEET
Spring Creek
Creek
Spring
water
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0.5
Scale 1:20000

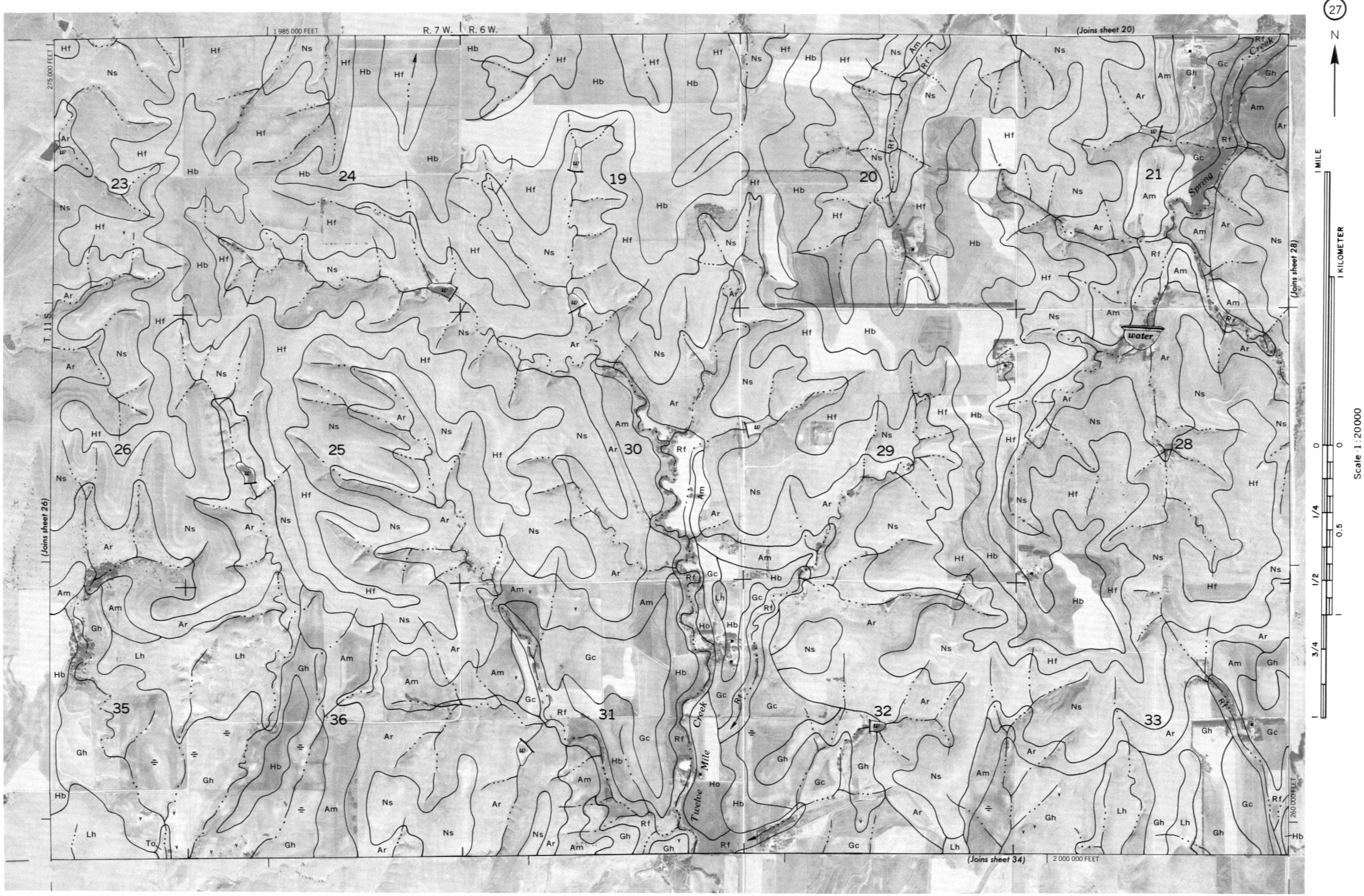

22
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 15)
R. 10 W.
1 885 000 FEET
275 000 FEET
T. 11 S.
(Joins sheet 23)
(Joins sheet 29)
1 865 000 FEET
260 000 FEET
RUSSELL COUNTY
19
20
21
22
23
30
29
28
27
26
31
32
33
34
35


23
N
(Joins sheet 16)
(Joins sheet 22)
(Joins sheet 24)
(Joins sheet 30)
R. 10 W. R. 9 W.
T. 11 S.
1 890 000 FEET
1 905 000 FEET
275 000 FEET
250 000 FEET
water
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5


24
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 17)
(Joins sheet 23)
(Joins sheet 25)
(Joins sheet 31)
R. 9 W.
R. 8 W.
T. 11 S.
Denmark
Spillman
Creek
Little
Timber
RAILROAD
22
23
24
19
20
27
26
25
30
29
34
35
36
31
32
18


25
N
(Joins sheet 18)
(Joins sheet 26)
(Joins sheet 32)
(Joins sheet 24)
R. 8 W.
T. 11 S.
1 935 000 FEET
1 955 000 FEET
275 000 FEET
260 000 FEET
water
Lost Creek
Spillman Creek
Lincoln Airport
R.R.
RAILROAD
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0.5
Scale 1:20000
Am
Ar
Ns
Hf
Hb
Gc
Gh
Lh
Rf
Ho
Rb
De
Nc
w


26
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 19)
R. 7 W.
1 980 000 FEET
275 000 FEET
T. 11 S.
(Joins sheet 25)
(Joins sheet 27)
(Joins sheet 33)
1 960 000 FEET
260 000 FEET
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35
Yauger Creek
Beaver Creek
LINCOLN

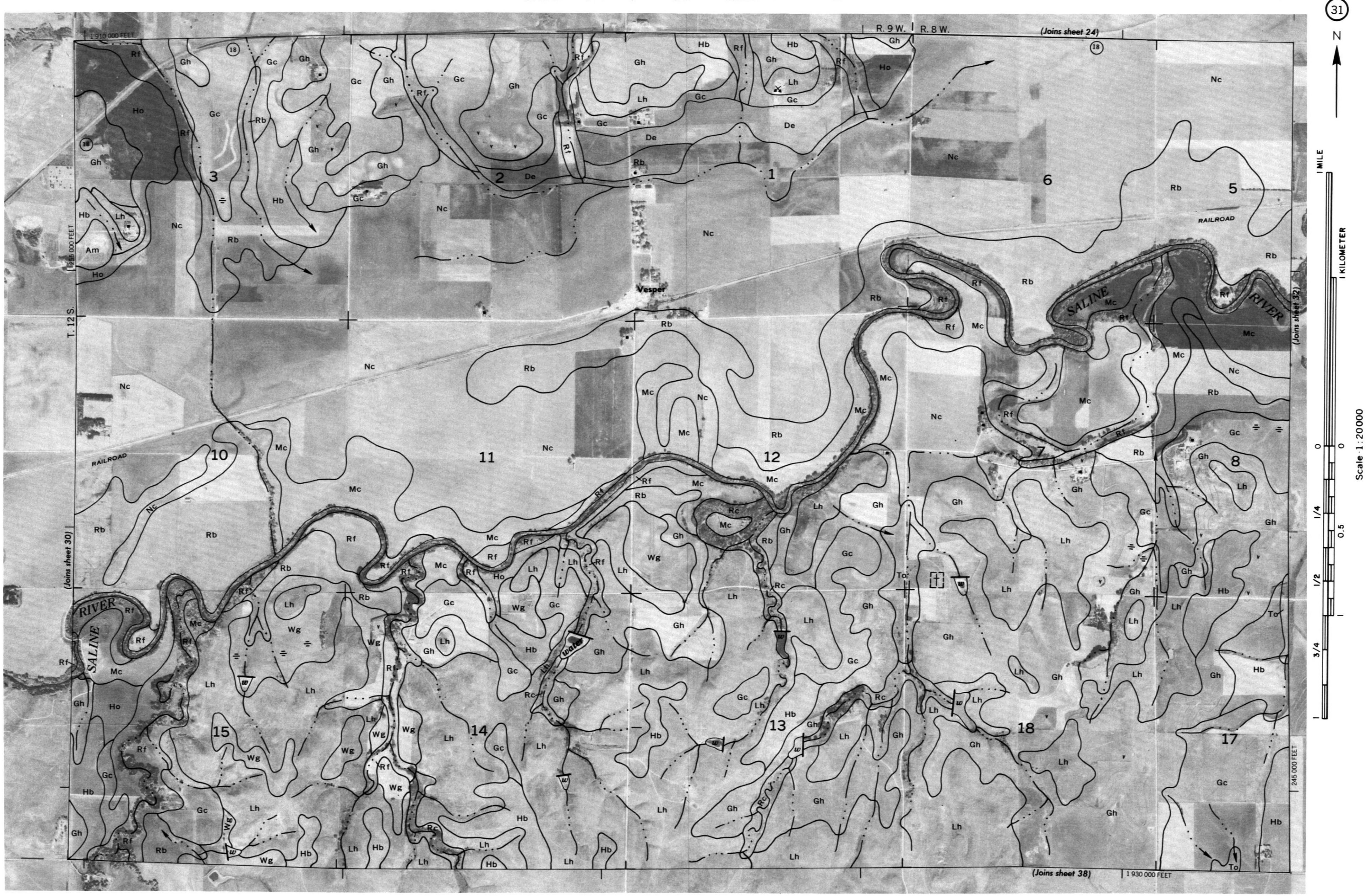

27
N
(Joins sheet 20)
(Joins sheet 28)
(Joins sheet 34)
(Joins sheet 26)
1 985 000 FEET
2 000 000 FEET
275 000 FEET
260 000 FEET
R. 7 W.
R. 6 W.
T. 11 S.
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36
Spring Creek
Twelve Mile Creek
water
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0.5
Scale 1:20000


28
N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 21)
R. 6 W.
2 025 000 FEET
275 000 FEET
(Joins sheet 27)
T. 11 S.
OTTAWA COUNTY
260 000 FEET
2 005 000 FEET
(Joins sheet 35)
22
23
24
25
26
27
34
35
36
water

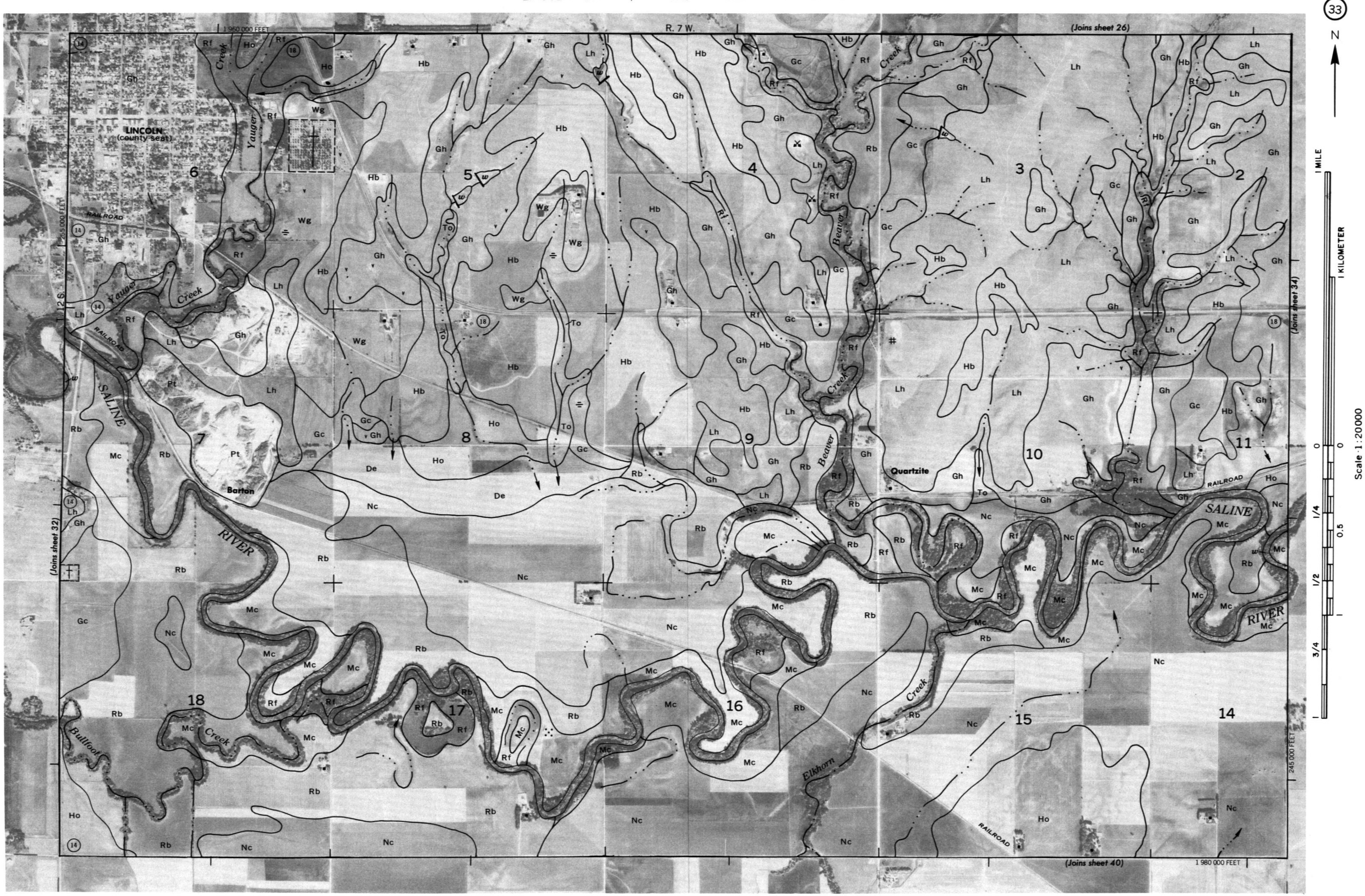

29
N
R. 10 W.
(Joins sheet 22)
(Joins sheet 30)
(Joins sheet 36)
1 865 000 FEET
1 885 000 FEET
255 000 FEET
245 000 FEET
T. 12 S.
RUSSELL COUNTY
RAILROAD
Wolf Creek
Blue Stem Creek
SALINE RIVER
SALINE R
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5

30


N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 23)
R. 10 W.
R. 9 W.
1 905 000 FEET
(Joins sheet 29)
(Joins sheet 31)
(Joins sheet 37)
1 890 000 FEET
T. 12 S.
Sylvan Grove
RAILROAD
SALINE RIVER
SALINE RIVER
Water

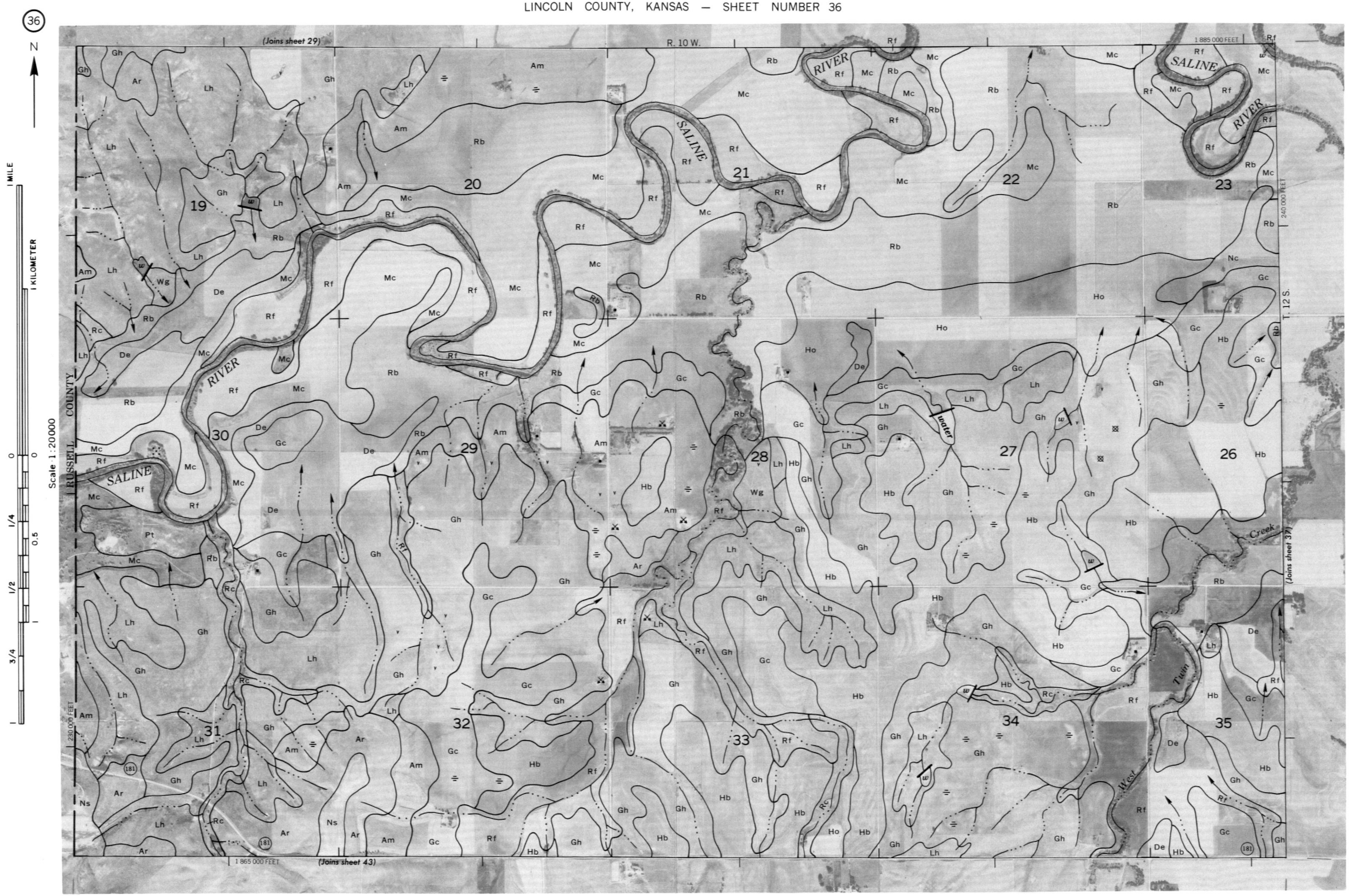

31
N
R. 9 W.
R. 8 W.
(Joins sheet 24)
1 910 000 FEET
T. 12 S.
Vesper
RAILROAD
RAILROAD
SALINE RIVER
RIVER SALINE
water
(Joins sheet 30)
(Joins sheet 32)
(Joins sheet 38)
1 930 000 FEET
245 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000


N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 25)
R. 8 W.
1 955 000 FEET
RAILROAD
Spillman
Creek
Lost
Creek
SALINE
RIVER
Spillman
Creek
SALINE
RIVER
(Joins sheet 31)
(Joins sheet 33)
T. 12 S.
245 000 FEET
1 935 000 FEET
(Joins sheet 39)
Bullfoot
Creek
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17


33
N
R. 7 W.
12 S.
(Joins sheet 26)
(Joins sheet 34)
(Joins sheet 40)
(Joins sheet 32)
1 960 000 FEET
1 980 000 FEET
255 000 FEET
245 000 FEET
LINCOLN
(county seat)
Yauger Creek
Beaver Creek
SALINE RIVER
Elkhorn Creek
Bullfoot Creek
Barton
Quartzite
RAILROAD
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5

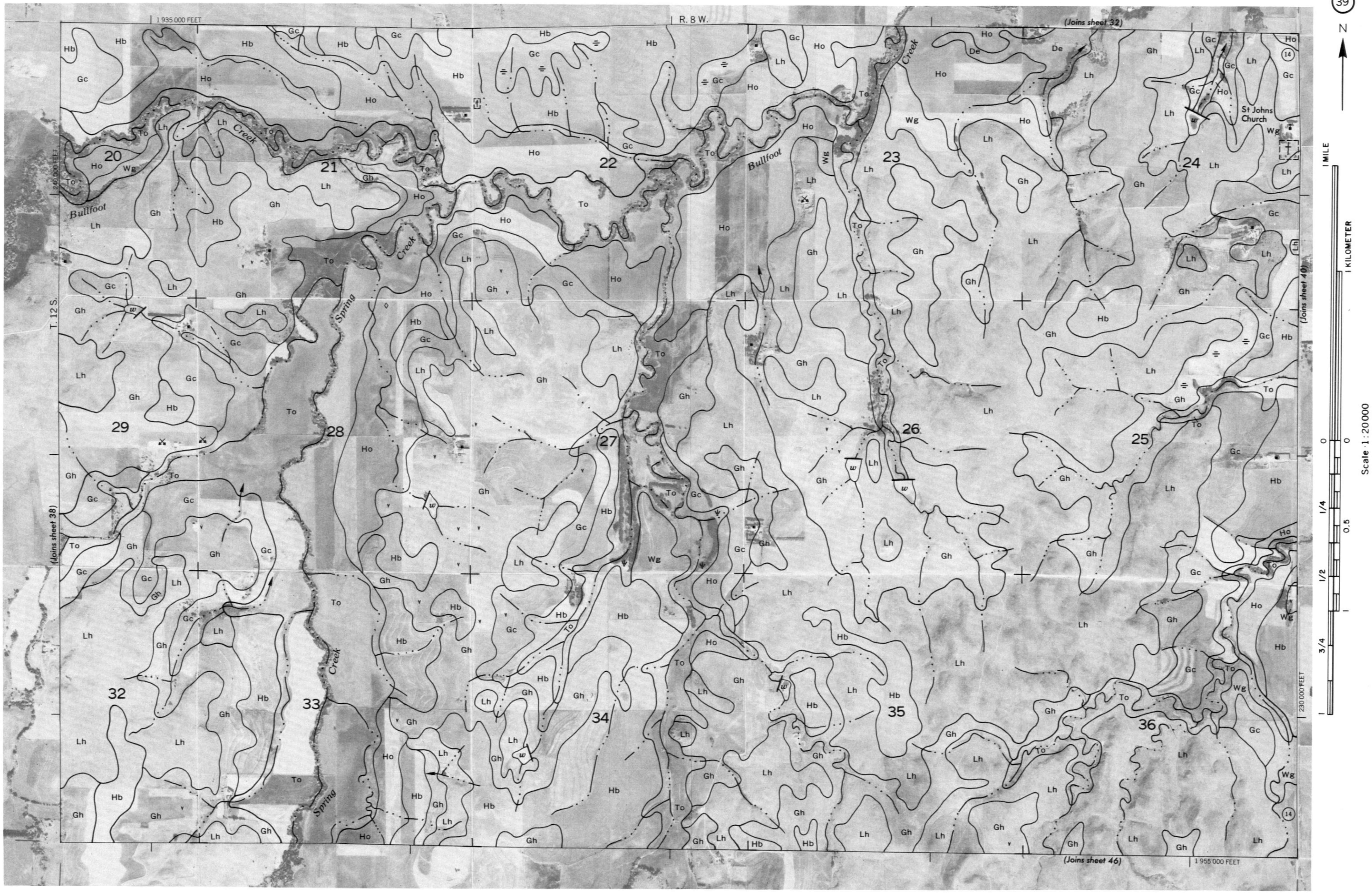

34
N
1 MILE
1 KILOMETER
Scale 1:20 000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 27)
R. 7 W.
R. 6 W.
2 000 000 FEET
(Joins sheet 33)
(Joins sheet 35)
(Joins sheet 41)
1 985 000 FEET
255 000 FEET
245 000 FEET
T. 12 S.
Twelve
Mile
Creek
SALINE
RIVER
RAILROAD
Shady
Bend
Brush
Creek
water

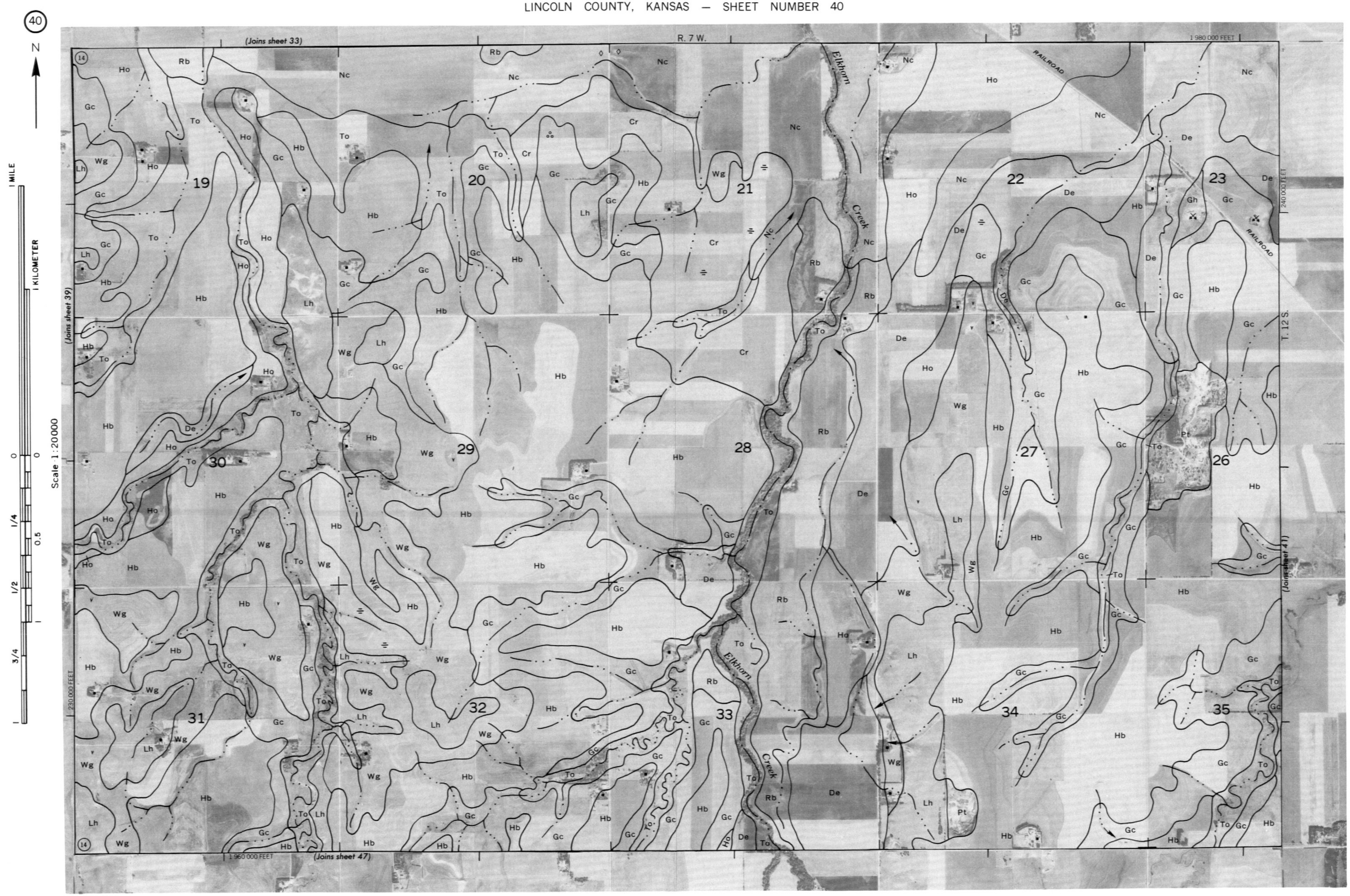

35
N
(Joins sheet 28)
R. 6 W.
2 005 000 FEET
T. 12 S.
255 000 FEET
(Joins sheet 34)
OTTAWA COUNTY
Beverly
RAILROAD
RAILROAD
SALINE RIVER
SALINE
RIVER
SALINE RIV
18
18
18
1
2
3
10
11
12
13
14
15
Hb
Gc
Gh
Ho
Lh
To
Cr
Rf
Wg
Nc
Rb
Mc
245 000 FEET
(Joins sheet 42)
2 025 000 FEET
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0.5
1
Scale 1:20000

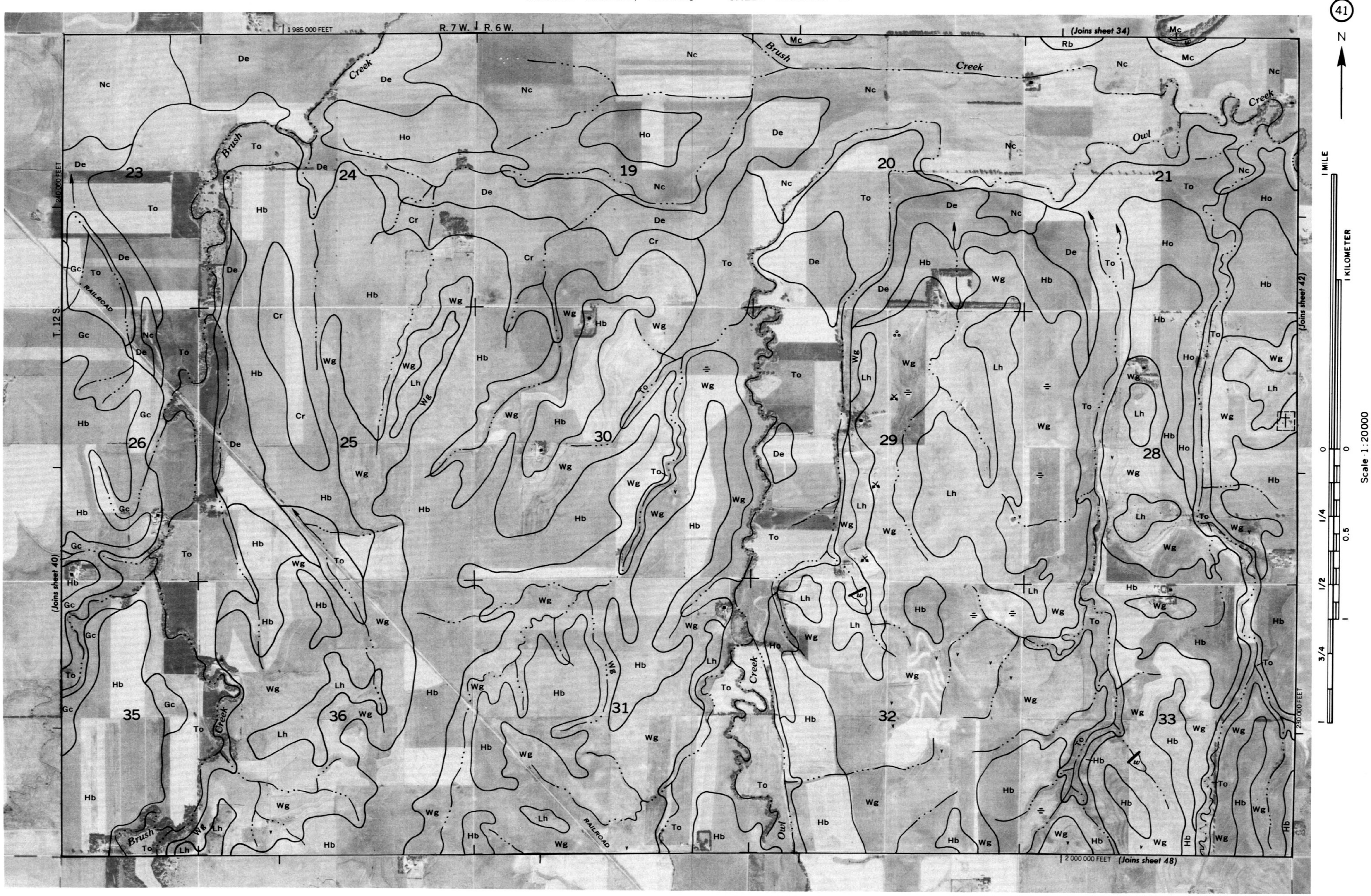

36
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 29)
R. 10 W.
1 885 000 FEET
240 000 FEET
T. 12 S.
(Joins sheet 37)
(Joins sheet 43)
1 865 000 FEET
230 000 FEET
RUSSELL COUNTY
SALINE RIVER
SALINE
RIVER
Creek
Twin
West
water
181
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35

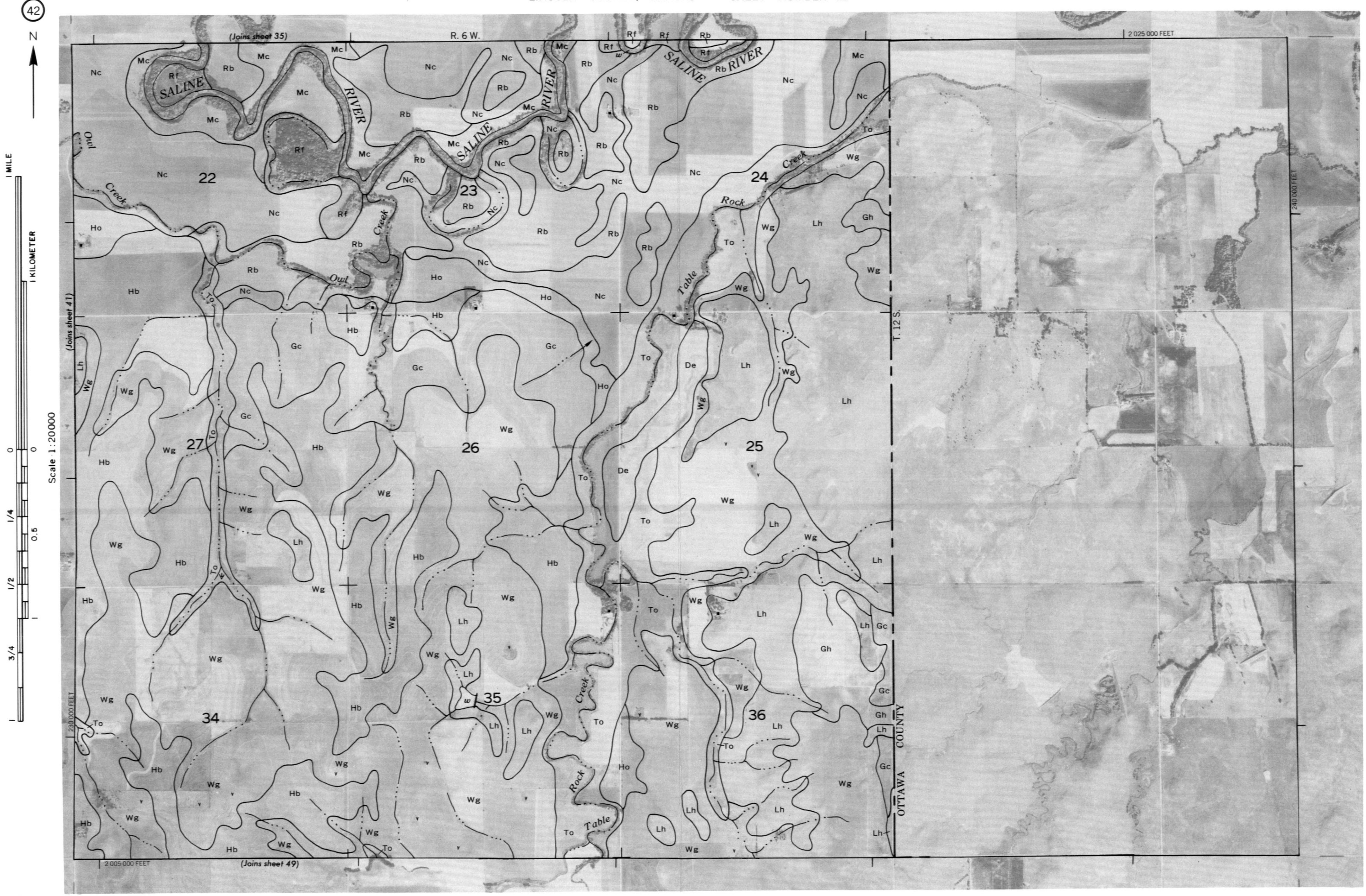

37
N
(Joins sheet 30)
(Joins sheet 38)
(Joins sheet 44)
(Joins sheet 36)
1 890 000 FEET
R. 10 W.
R. 9 W.
240 000 FEET
T. 12 S.
230 000 FEET
1 905 000 FEET
SALINE RIVER
SALINE
RIVER
Twin Creek
East Twin Creek
West
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5

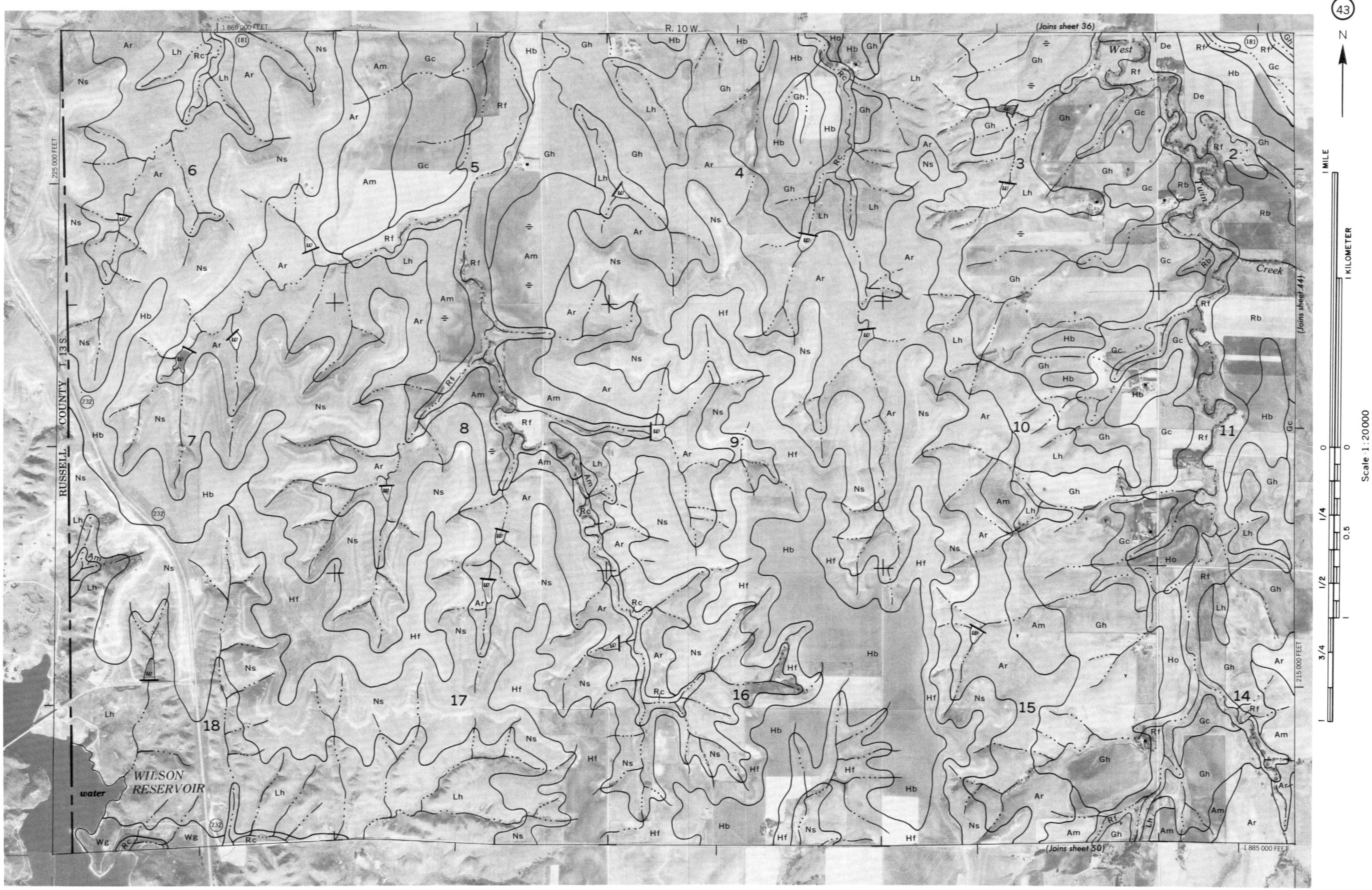

38
N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 31)
(Joins sheet 37)
(Joins sheet 39)
(Joins sheet 45)
R. 9 W.
R. 8 W.
T. 12 S.
1 930 000 FEET
1 910 000 FEET
230 000 FEET
240 000 FEET
Bullfoot Creek
Emmanuel Church
19
20
22
23
24
25
26
27
29
30
31
32
34
35
36

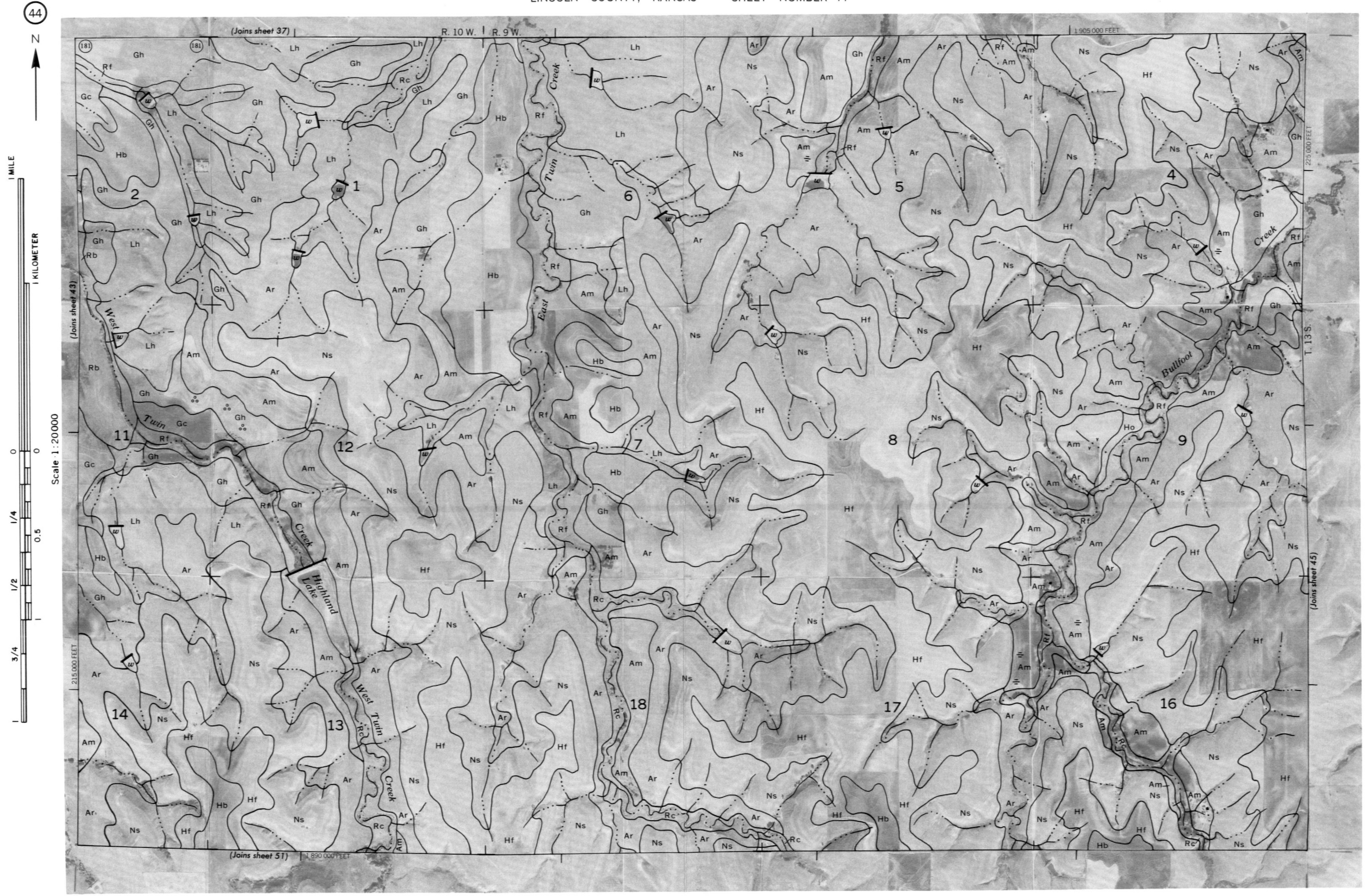

39
N
1 935 000 FEET
R. 8 W.
(Joins sheet 32)
(Joins sheet 40)
(Joins sheet 38)
(Joins sheet 46)
1 955 000 FEET
230 000 FEET
T. 12 S.
Bullfoot Creek
Spring Creek
St Johns Church
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
14
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
Scale 1:20000

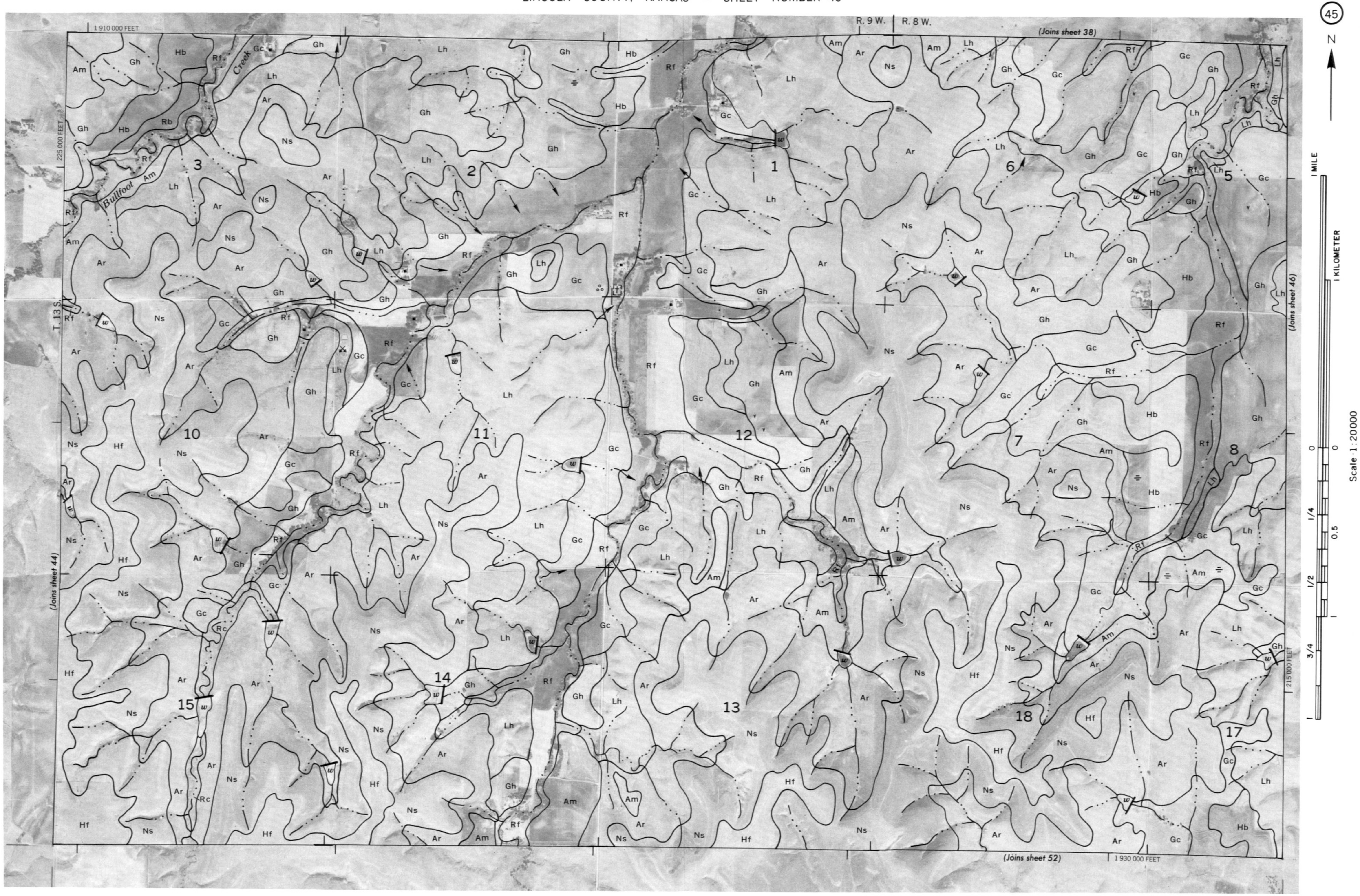

40
N
(Joins sheet 33)
R. 7 W.
1 980 000 FEET
RAILROAD
RAILROAD
Elkhorn
Creek
Elkhorn
Creek
240 000 FEET
T. 12 S.
(Joins sheet 39)
(Joins sheet 41)
(Joins sheet 47)
230 000 FEET
1 960 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
14
14
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35


41
N
1 985 000 FEET
R. 7 W. | R. 6 W.
(Joins sheet 34)
(Joins sheet 42)
(Joins sheet 40)
2 000 000 FEET (Joins sheet 48)
230 000 FEET
240 000 FEET
T. 12 S.
Brush Creek
Owl Creek
RAILROAD
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
Scale 1:20000


42
N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 35)
R. 6 W.
2 025 000 FEET
240 000 FEET
(Joins sheet 41)
T. 12 S.
230 000 FEET
2 005 000 FEET
(Joins sheet 49)
OTTAWA COUNTY
SALINE RIVER
Owl Creek
Rock Creek
Table Rock Creek
22
23
24
25
26
27
34
35
36

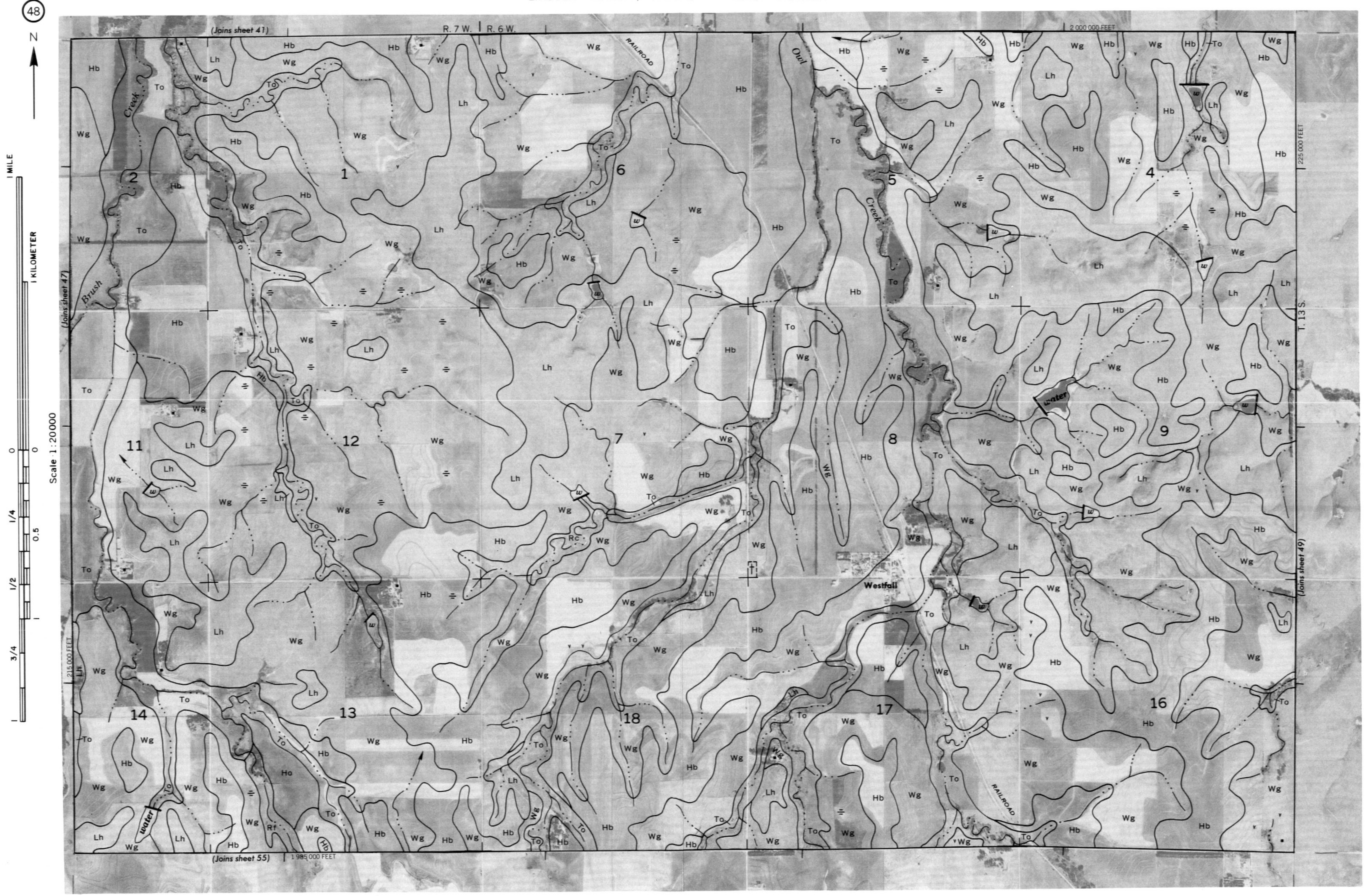

43
N
1 865 000 FEET
R. 10 W.
(Joins sheet 36)
(Joins sheet 44)
(Joins sheet 50)
1 885 000 FEET
225 000 FEET
215 000 FEET
RUSSELL COUNTY
T. 13 S.
West
Creek
WILSON RESERVOIR
water
1 MILE
1 KILOMETER
Scale 1:20000

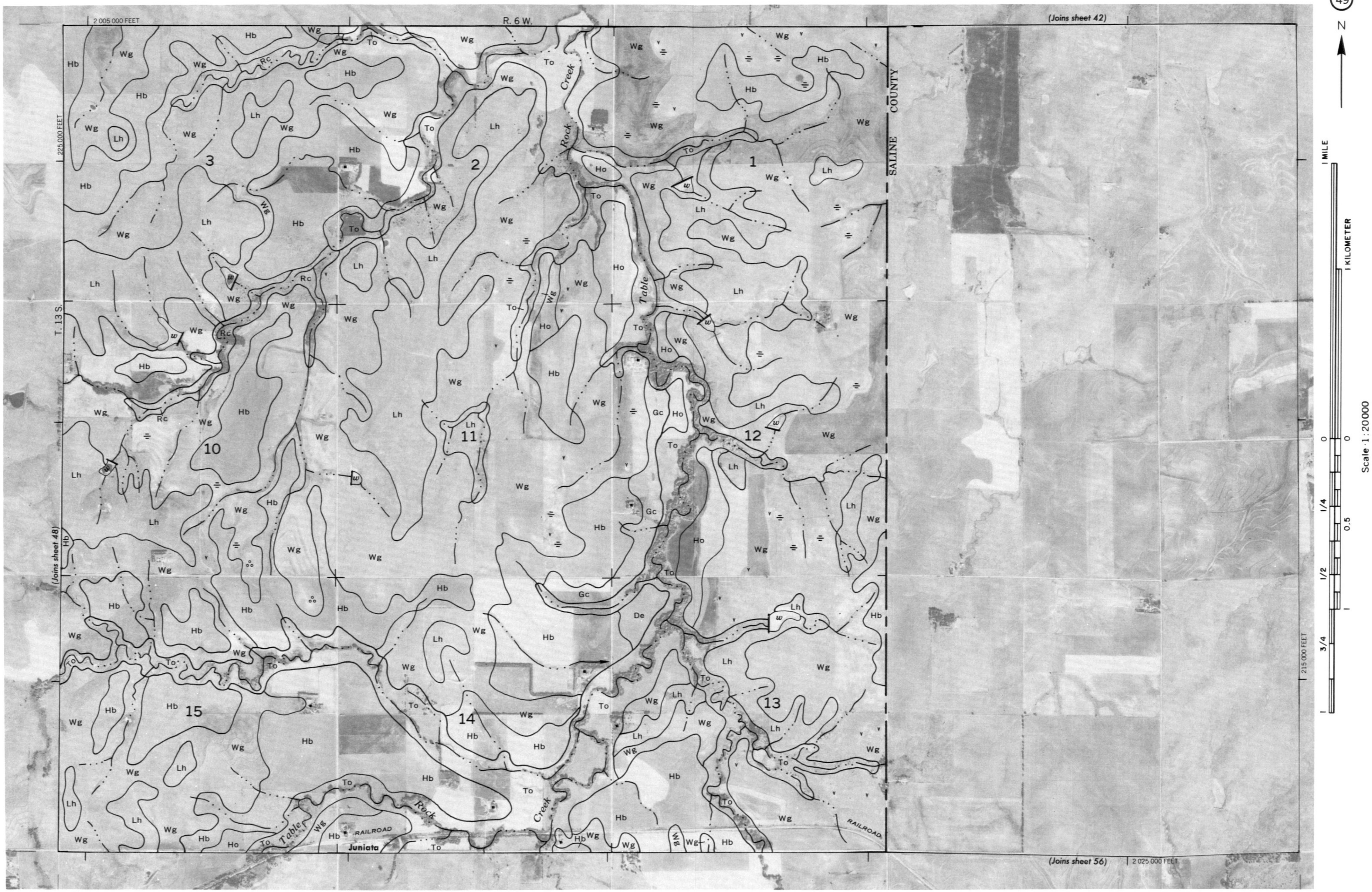

44
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 37)
R. 10 W.
R. 9 W.
1 905 000 FEET
(Joins sheet 43)
(Joins sheet 45)
(Joins sheet 51)
1 890 000 FEET
225 000 FEET
215 000 FEET
T. 13 S.
181
East Twin Creek
West Twin Creek
Twin Creek
Highland Lake
Bullfoot Creek
Creek


45
N
R. 9 W.
R. 8 W.
T. 13 S.
(Joins sheet 38)
(Joins sheet 46)
(Joins sheet 52)
(Joins sheet 44)
1 910 000 FEET
1 930 000 FEET
225 000 FEET
215 000 FEET
Bullfoot Creek
1 MILE
1 KILOMETER
Scale 1:20000


46
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 39)
R. 8 W.
1 955 000 FEET
225 000 FEET
T. 13 S.
(Joins sheet 45)
(Joins sheet 47)
215 000 FEET
1 935 000 FEET
(Joins sheet 53)
Spring Creek
Spring Creek
Spring
West Elkhorn Creek
14

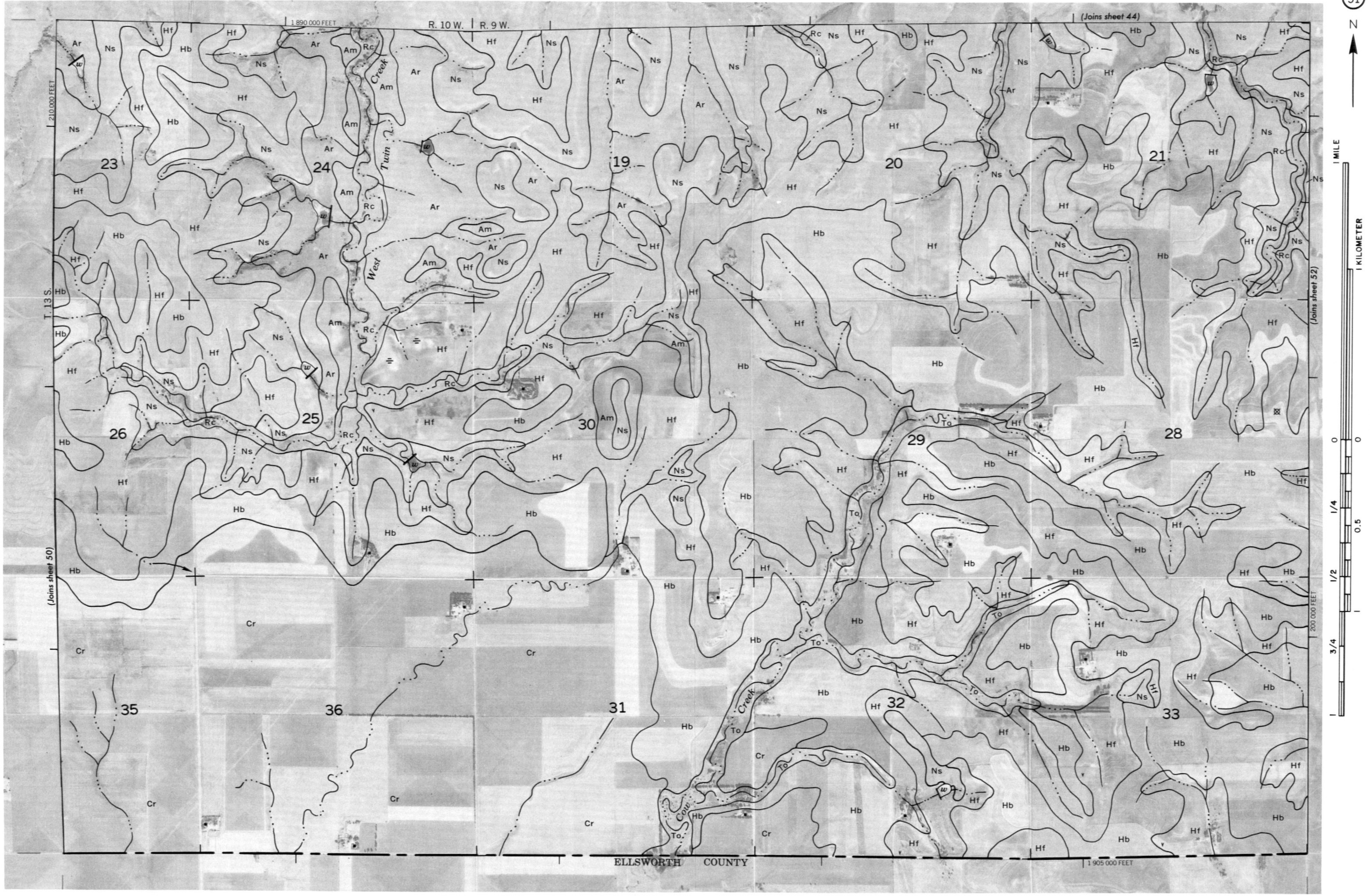

47
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
1 960 000 FEET
R. 7 W.
(Joins sheet 40)
(Joins sheet 48)
(Joins sheet 54)
(Joins sheet 46)
1 980 000 FEET
225 000 FEET
215 000 FEET
T. 13 S.
St Pauls Church
West Elkhorn Creek
East Elkhorn Creek
Brush Creek
2
3
4
5
6
7
8
9
10
11
14
15
16
17
18

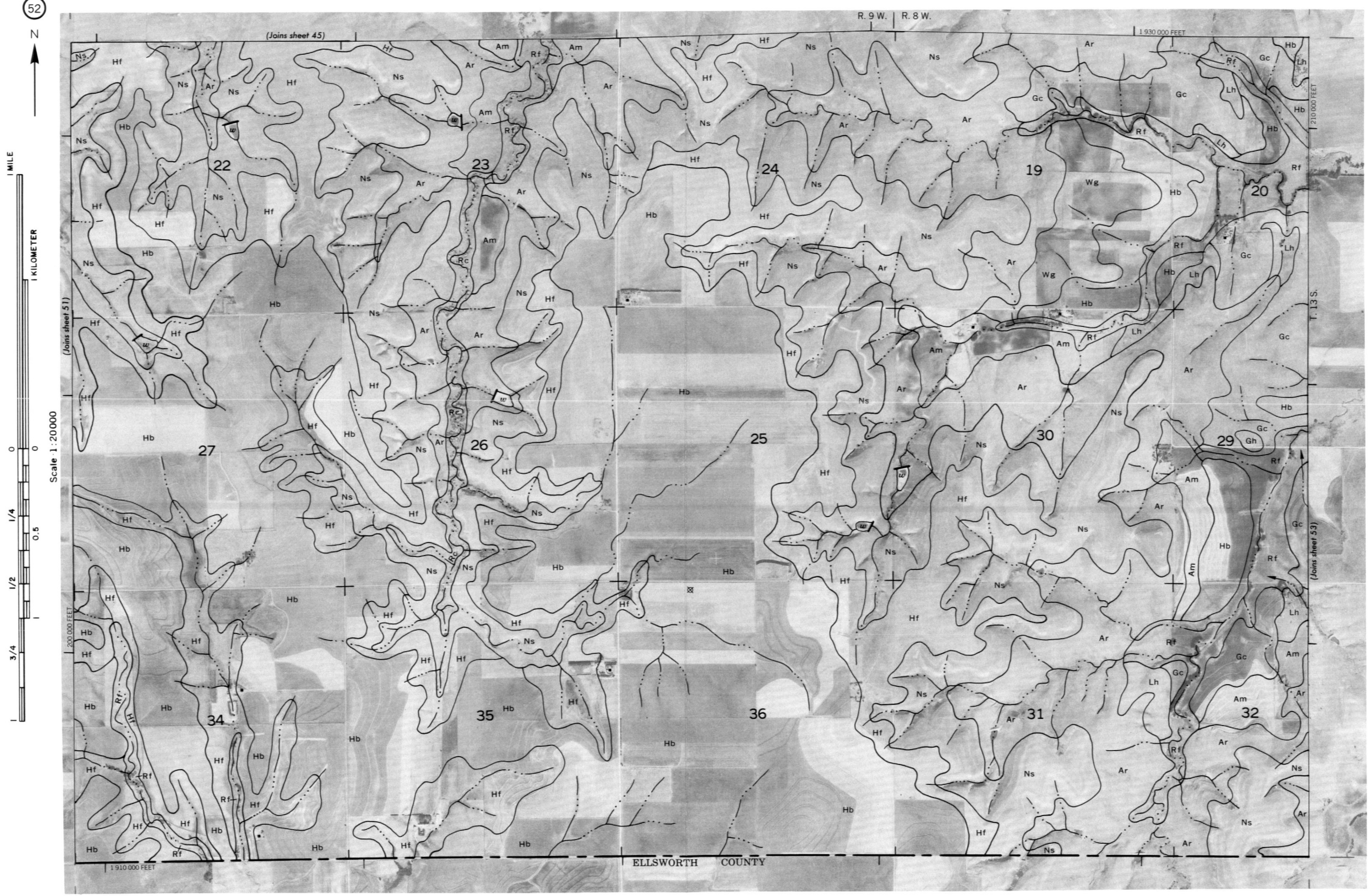

48
N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 41)
R. 7 W.
R. 6 W.
2 000 000 FEET
(Joins sheet 47)
(Joins sheet 49)
(Joins sheet 55)
1 985 000 FEET
215 000 FEET
T. 13 S.
Brush Creek
Owl Creek
RAILROAD
Westfall

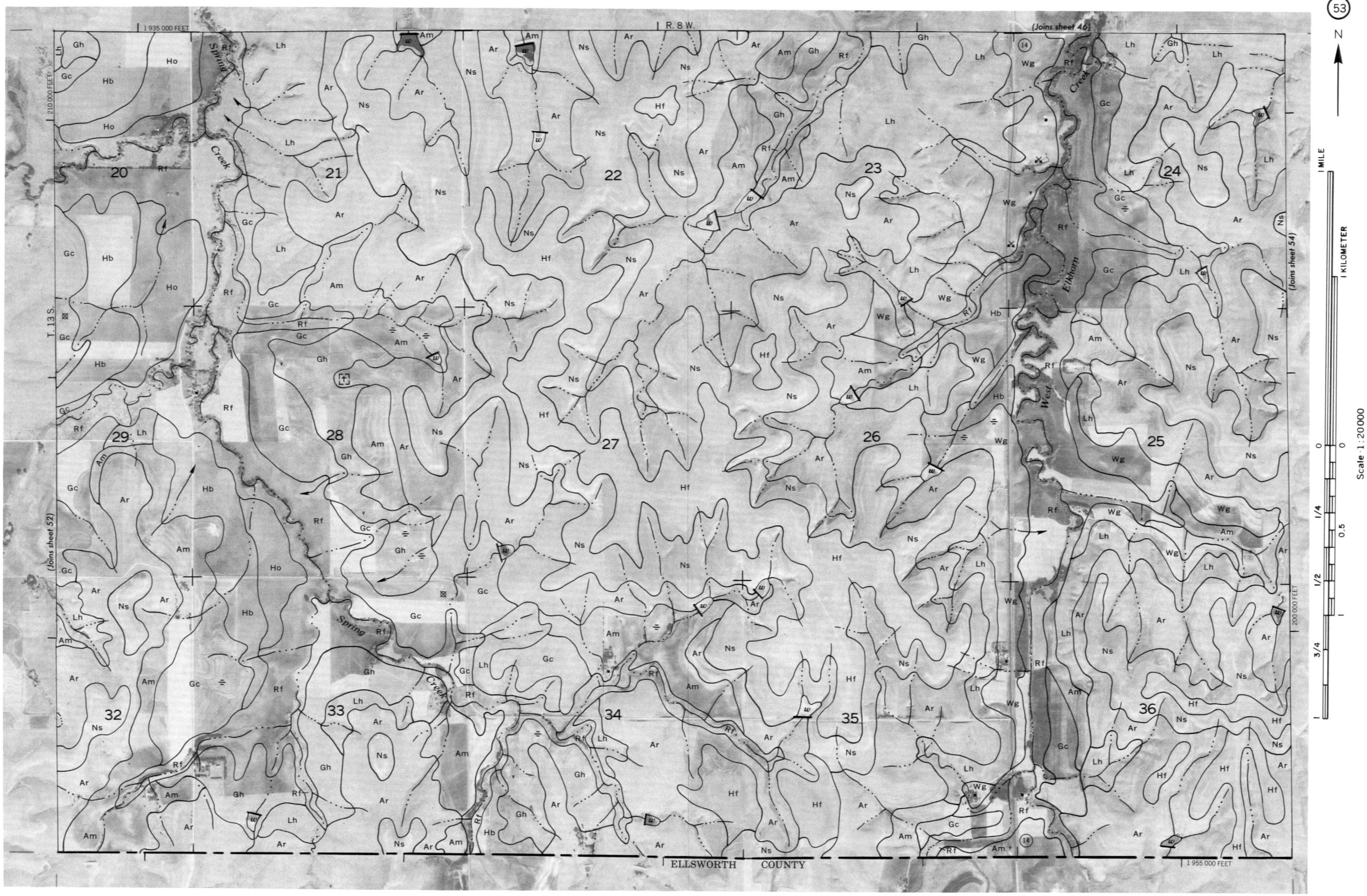


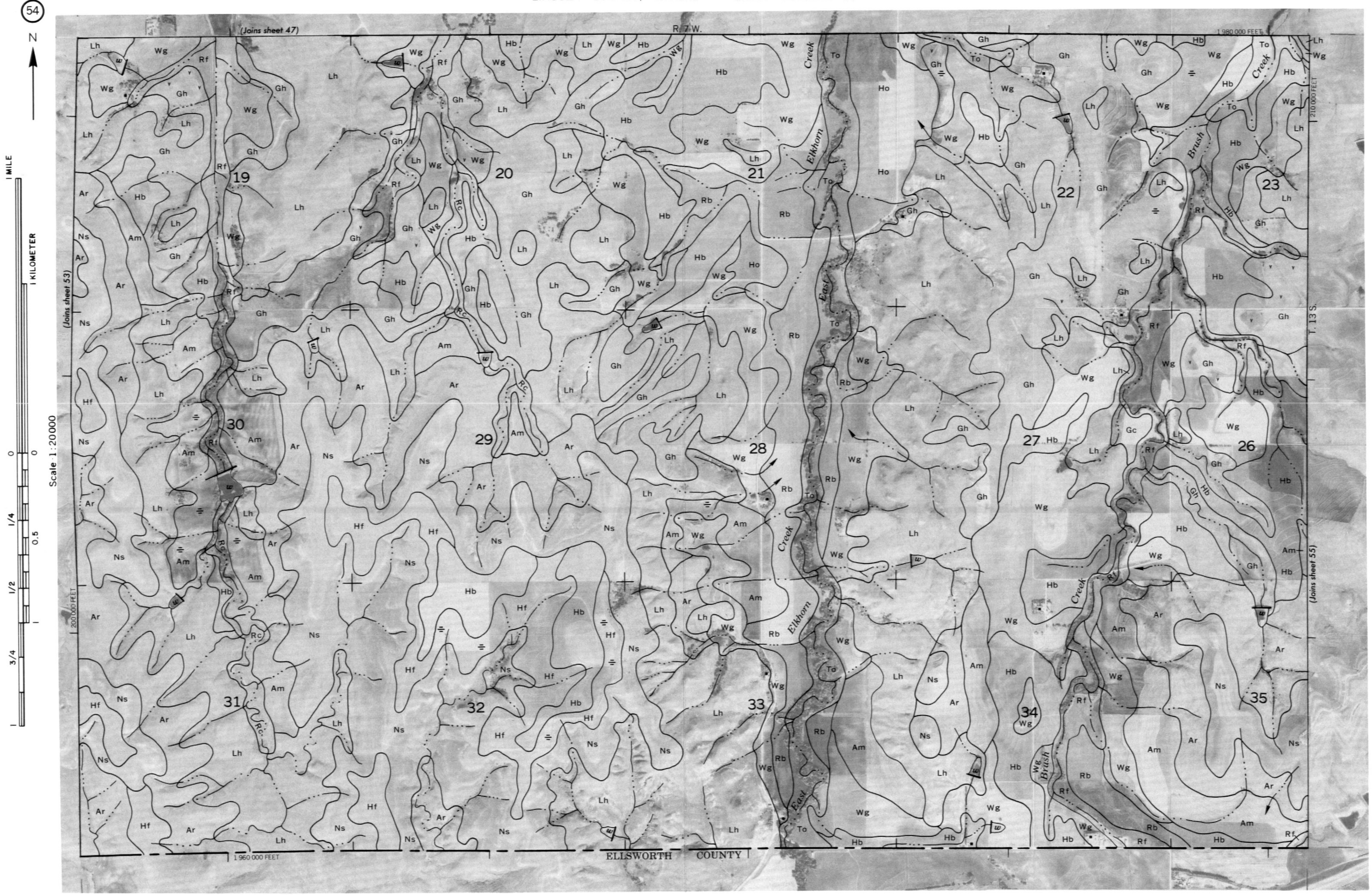
(Joins sheet 42)
R. 6 W.
2 005 000 FEET
225 000 FEET
T. 13 S.
(Joins sheet 48)
(Joins sheet 56)
2 025 000 FEET
215 000 FEET
SALINE COUNTY
Rock Creek
Table Rock Creek
RAILROAD
Juniata
N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0.5
Scale 1:20000

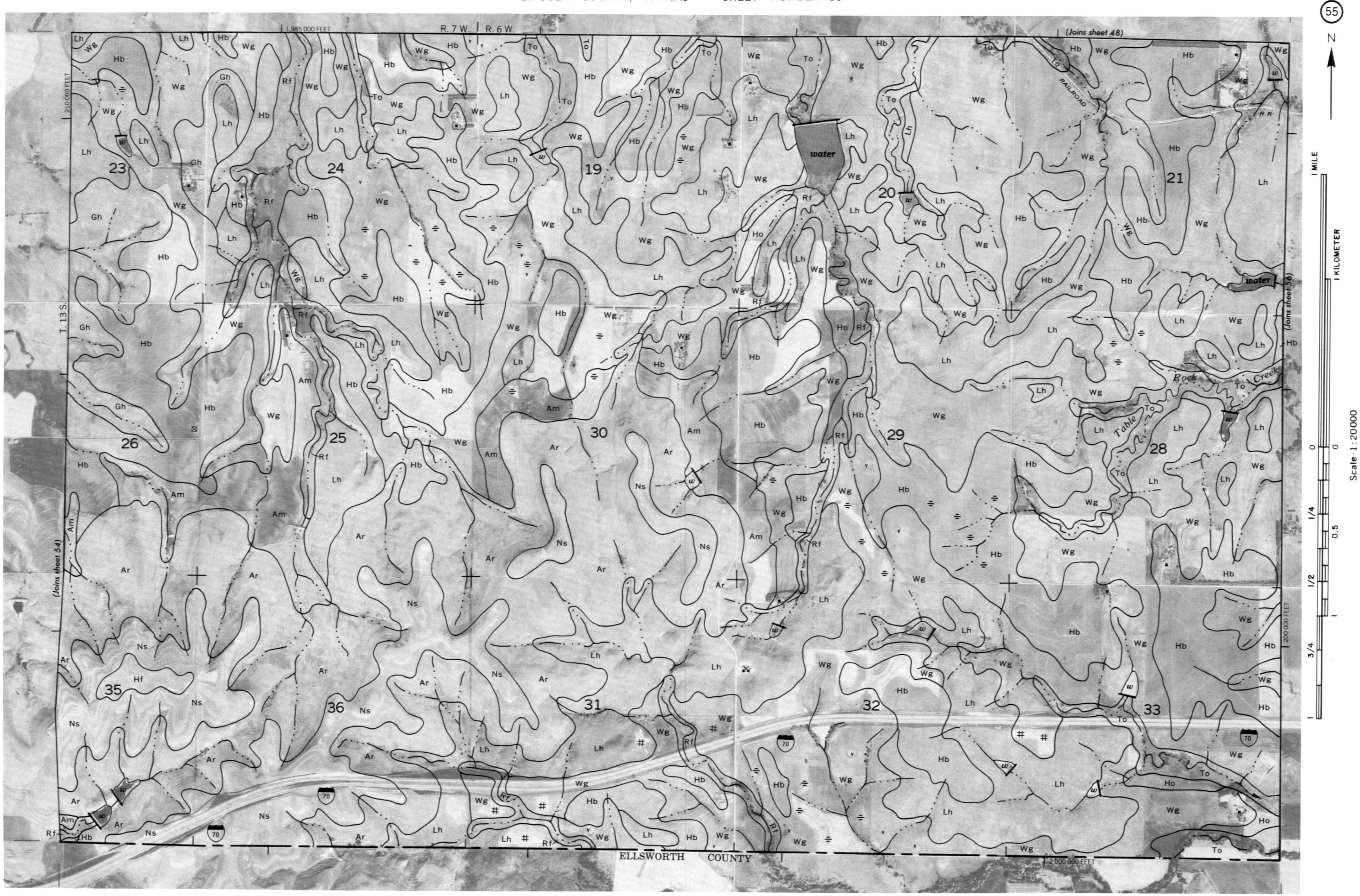

50
N
(Joins sheet 43)
R. 10 W.
1 885 000 FEET
210 000 FEET
T. 13 S.
(Joins sheet 51)
WILSON RESERVOIR
RUSSELL COUNTY
ELLSWORTH COUNTY
1 865 000 FEET
200 000 FEET
Hell Creek
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35
water

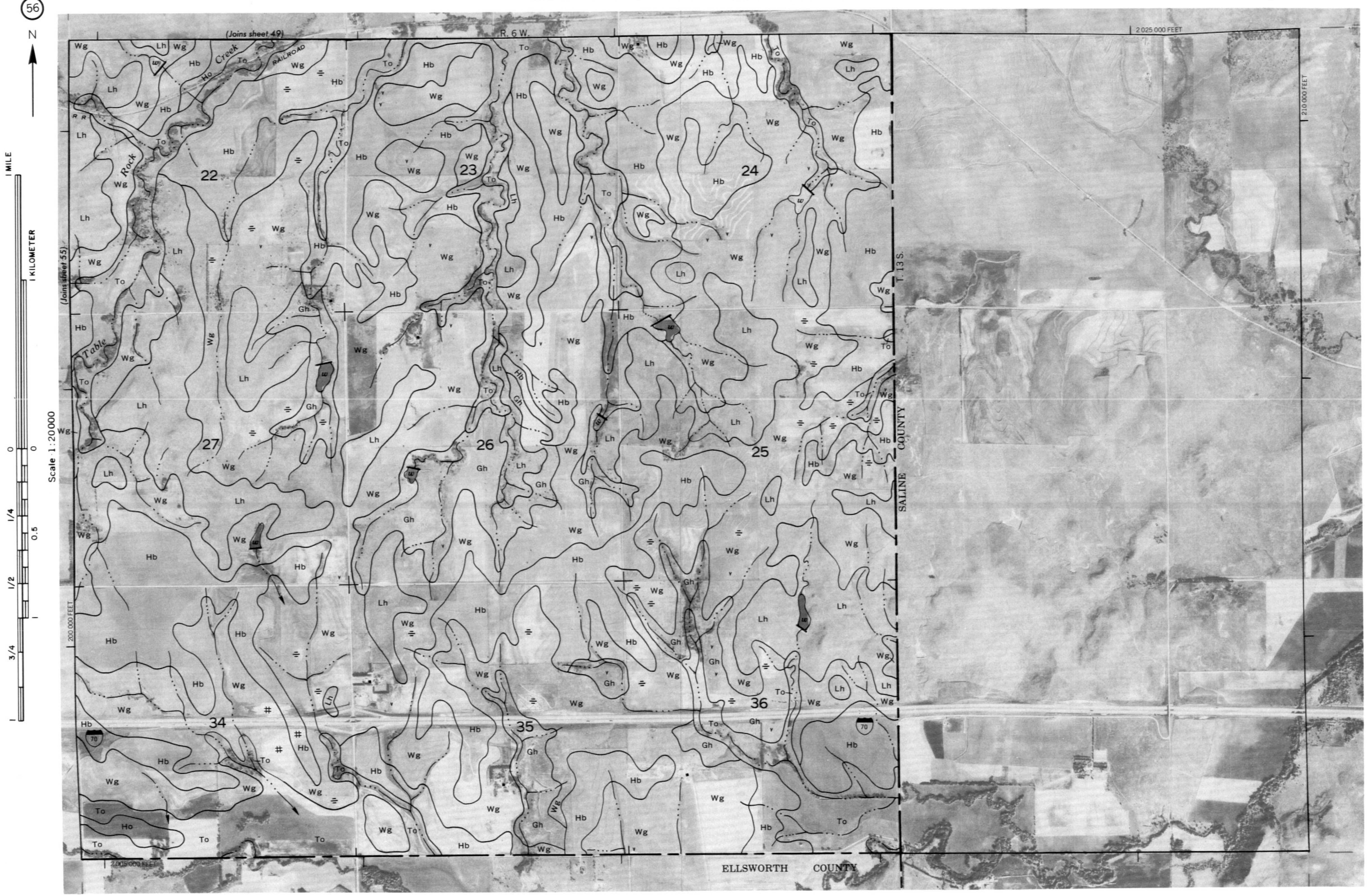

1 890 000 FEET
R. 10 W.
R. 9 W.
(Joins sheet 44)
(Joins sheet 52)
(Joins sheet 50)
T. 13 S.
210 000 FEET
200 000 FEET
1 905 000 FEET
West Twin Creek
Cow Creek
ELLSWORTH COUNTY
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36
N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
Scale 1:20000


N
1 MILE
1 KILOMETER
Scale 1:20 000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 45)
(Joins sheet 51)
(Joins sheet 53)
R. 9 W.
R. 8 W.
T. 13 S.
1 930 000 FEET
1 910 000 FEET
210 000 FEET
200 000 FEET
ELLSWORTH COUNTY
19
20
22
23
24
25
26
27
29
30
31
32
34
35
36


53
N
1 935 000 FEET
R. 8 W.
(Joins sheet 46)
(Joins sheet 54)
(Joins sheet 52)
210 000 FEET
200 000 FEET
1 955 000 FEET
T. 13 S.
Spring
Creek
West
Elkhorn
Creek
ELLSWORTH
COUNTY
20
21
22
23
24
29
28
27
26
25
32
33
34
35
36
14
14
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0
0.5
1


54
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 47)
R. 7 W.
1 980 000 FEET
210 000 FEET
T. 13 S.
(Joins sheet 53)
(Joins sheet 55)
200 000 FEET
1 960 000 FEET
ELLSWORTH COUNTY
Elkhorn Creek
East Elkhorn Creek
Brush Creek
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35


55
N
(Joins sheet 48)
(Joins sheet 56)
(Joins sheet 54)
1 985 000 FEET
210 000 FEET
200 000 FEET
2 000 000 FEET
R. 7 W.
R. 6 W.
T. 13 S.
RAILROAD
R R
water
Rock Creek
Table
ELLSWORTH COUNTY
70
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
Scale 1:20000


56
N
(Joins sheet 49)
R. 6 W.
2 025 000 FEET
210 000 FEET
(Joins sheet 55)
T. 13 S.
SALINE COUNTY
ELLSWORTH COUNTY
200 000 FEET
2 005 000 FEET
Rock Creek
Table Rock
RAILROAD
R R
22
23
24
25
26
27
34
35
36
70
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
Scale 1:20000